Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LV. NEW YORK, THURSDAY, MAY 5, 1910. No. 18.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK

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TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All Other Countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1909 was 945,850. Of this issue 22,000 copies are printed.

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INCANDESCENT LAMP RATINGS

It frequently happens in practical affairs that after a sharp line of division in opinion has been brought about as to what course in a given direction should be adopted for the future, some new event occurs which changes the entire field of discussion, and makes the opponents forget their antagonism. The rating of incandescent lamps is a case of this kind. For some years, and until recently, there had existed a controversy concerning the proper method of rating lamps. The original method of rating incandescent lamps was on the basis of maximum horizontal intensity or candle-power. Then the incandescent lamp manufacturers were sorely pricked by the thorns of conscientiousness and changed their rating from the maximum to mean horizontal candle-power, a proceeding at which their gas rivals gazed in surprise. Later came the photometrists and specialists who claimed that the only right and proper way to rate a lamp was on the basis of mean spherical candle-power. Parenthetically it may be added that Mr. Edward Weston advocated the mean spherical rating of electric illuminants at the time of their first introduction. Fundamentally, of course, this is the correct method, but custom, competition and inexperience with spherical measurement made converts very slowly to the new idea. Over the breach between the contestants for the horizontal and the spherical ratings came the new metallic filaments of tantalum, osmium and tungsten. These newcomers changed everything. It has become customary to rate tungsten lamps in watts, rather than in candles. Provided that the luminous efficiency is up to the proper standard there can be no objection to a watt rating. It is definite and precise. But a subsidiary reference to luminous intensity is needed as a subsidiary rating. This affords a chance for spherical candle-power ratings to be introduced without difficulty. Thus, a 40-watt lamp of 25 spherical candles would be very satisfactorily defined and rated. Moreover, an 80-watt lamp would then be of 50 spherical candles at the same luminous efficiency.

DEPRECIATION OF ELECTRICAL PROPERTIES.

The subject of depreciation of electrical properties was discussed at a recent professional meeting in Chicago by a number of men prominent in engineering circles and identified with different branches of electric public service work. One of the chief points in connection with the discussion, which hinged on a paper by Mr. William B. Jackson, was a practically unanimous agreement that some kind of a fund should be set aside by every electric public-service corporation to cover the cost of extraordinary renewals and repairs. The main differences of opinion were as to the exact "labels" which should be applied to the various expenses of keeping a property so repaired and renewed that there shall be no impairment of the original investment. A number of engineers and public-service officials take the position that if "maintenance" is properly looked after there is nothing left for a "depreciation" reserve to take care of. If in maintenance are to be included all of the necessary

repairs and renewals of whatever nature, doubtless the most ardent advocate of depreciation reserve funds would acquiesce in the assertion that maintenance properly followed up is sufficient for all purposes. However, the ordinary use of the term maintenance does not include such unusual expenses as the replacement of one generating unit with another, and similar radical changes in the original equipment. Depreciation, as the word is now commonly used, includes the extraordinary repairs and renewals caused by the wearing out or obsolescence of apparatus and equipment. If such changes in equipment were in fact distributed evenly over a considerable period of time, the setting aside arbitrarily of a certain fund to cover them would not be necessary. The fact that these renewals, however, are not necessary until the original apparatus has been in service a number of years, makes desirable the laying aside of a fund in advance of the actual expenditure. A company or municipality which is not making some such provision is operating on an unsound basis.

At least one large electric railway lays aside for depreciation a certain percentage of gross receipts. The argument in favor of this practice is that a considerable percentage of the total depreciation on the property is caused by the amount of use which is made of the property per year, or in other words, by the wear and tear, which is likely to be more nearly proportional to the gross amount of business done than to the time elapsed. This is especially true of an electric railway property where the wearing out of rails, cars and trolley wire depends on the amount of traffic. In the electric lighting field the depreciation of apparatus is not so nearly in proportion to the gross business done. The investment outside the station, which is seldom less than half of the total investment, depreciates with time and other factors not dependent on the amount of business done. In the power station the wearing out of generating machinery may be partially dependent on the load at which it is operated, and a power plant with a high load factor may find its apparatus wearing out more quickly than one with a low load factor, in which latter case the apparatus would be lying idle a larger proportion of the total time. As a matter of fact, however, depreciation of power-plant machinery has so far been more nearly proportional to the time it has been installed than to the kw-hours output. As far as electric lighting plants are concerned, depreciation figured on the time basis is most accurate and convenient to apply.

THE DIVERSITY FACTOR.

The term "diversity factor," which has come into use during the last few years, is commonly accepted to mean the ratio between the sum of the maximum demands of various customers and the total maximum demand on the generating station. If, for example, two consumers have each a maximum demand of 50 kw, but the load of one comes on only in the morning and that of the other only in the afternoon, the total maximum demand on the station by the two consumers is only 50 kw, though the sum of the individual maximum demands is 100 kw. The diversity factor in this case may be expressed either by a percentage, as 50 per cent, or as the reciprocal of this, namely, 2. It has been customary to present as an argument for central-station against isolated-plant service the superior economy of a large central-station plant over that of the small isolated plant. Sufficient consideration, however, has not been given to the diversity of a central-station load which enables the supply of the combined needs of a number of consumers with much less generating capacity than required if these consumers were each to install its individual isolated plant. The central station, in many cases, is saddled with heavy investments in distribution systems which, of course, the isolated plant does not have to carry. The fixed charges on this investment would, in many cases, wipe out the advantage enjoyed by the central station in the way of greater fuel and labor economies, but in compensation the central station is enabled to serve consumers with a total capacity of generating plant far less than the combined individual maximum demands. It is evident in these days when central-station power is being purchased by large electric railway companies that something more than mere difference in size of plant enters into the cost of electrical energy to consumers.

A recent paper by Mr. H. B. Gear, of the Commonwealth Edison Company, Chicago, gives the results of a systematic study of the load diversity of that company, which until recently had maximum demand meters on the services of all of its customers. Mr. Gear's figures show that for each 100 kw combined maximum demand, 16 kw are required in generating station capacity for residence customers; 43.5 kw for commercial lighting; 39.5 kw for scattered motor load, and 69.5 kw for large lighting or motor customers. There will evidently be also a diversity factor with respect to these different classes of loads, as their peaks will not coincide. It is frequently assumed that the maximum demand on small central stations is about one-half the total connected load, but this assumption appears to be based on conditions of some years ago and probably requires considerable modification at the present time. Mr. Gear's figures show that under city conditions all classes of lighting show a lower diversity factor than 50 per cent, except for large customers using both lamps and motors. Applying the diversity factor to the investment required, Mr. Gear evolved some rather startling figures. The investment per kilowatt of annual maximum demand on the generating station was, under certain assumptions, estimated at $820 for scattered residence lighting: $500 for dense residence lighting; $350 for commercial lighting, and $250 for large motor or lighting loads. As a basis for these figures the generating station was figured at $150 per kilowatt; transmission lines at $35; transformers at $7 to $10, and meters at $10 apiece. Meters are thus 21 per cent of the total investment in scattered residence lighting and 34 per cent in dense residence lighting, while feeders and mains are 52 per cent in scattered residence lighting and 26 per cent in dense residence lighting. The fixed charges for distribution and metering investment are therefore the most serious obstacles to be overcome in residence business. It is fortunate for the prosperity of the central-station business in smaller towns that some of these figures on investment are considerably higher than those applying to small systems.

IMPROVED TELEPHONE SERVICE.

We note with much interest that application has been made by the American Telephone & Telegraph Company for permission to lay telephone conduits on the route between Philadelphia, Baltimore and Washington, as part of a comprehensive scheme of connecting the chief cities of the country by underground telephone lines. It is apparently not intended to displace the overhead system, but rather to supplement it in such manner that service will not be interrupted by storms, however

severe. The present move is apparently the result of the valuable lesson taught by the complete failure of communications at the time of the last presidential inauguration. The change from overhead to underground service, even in part, is an important one which would have been not many years ago both impracticable and well-nigh impossible. Telephone service has become year by year more of an absolute necessity in modern life. It no longer ranks as a convenience or a luxury, but is part and parcel of the business and domestic life of the country, and consequently interruptions of service are simply intolerable. The very magnitude of the business compels changes like the one now being inaugurated, to the end that whatever happens communications may not be interrupted between the important centers by any contingencies whatever.

As the telephone service has increased it has become extremely difficult to keep overhead lines in order. The immense number of separate circuits demanded for telephone communications puts a burden on the line structure of a kind immensely more troublesome from an engineering standpoint than that imposed even by the greatest and most important electrical power transmissions. It is neither impracticable nor difficult to build an overhead power line so that it will not be carried down by anything short of an earthquake or a cyclone, and probably not by these. The wires concerned are few and strong; the supports are skilfully designed and the insulators, particularly now that the suspension type is becoming common, are particularly well adapted to stand up under the most severe strains. With a telephone system the case is absolutely different and the engineering problem involved in overhead construction becomes well-nigh insoluble. The number of individual circuits to be dealt with in an important interurban line rises to dozens or scores. The wires cannot be large without incurring enormously proportionate expense, and the strain of wind and weather on the line is practically proportional to the number of wires, while the individual wires are far weaker than in the case of a transmission system. Even if the problem is somewhat simplified by cabling the wires, the cable itself is weak in proportion to its weight and bulk, and its support involves grave difficulties. Hence, the penalty of success in development of the telephone business is increased expenditure for providing underground service, at least as aid to the overhead lines.

Not many years ago, too, the talking through a long underground cable would have been almost intolerably bad. To-day, thanks to the Pupin "loading system," practical details of which are given on another page, and to improved cable construction, the proposed scheme of interurban conduits can be carried out with the assurance of success. Recent experiments with loaded submarine cables have shown the advantages that can be gained and give encouragement that no material difficulties will be met in the new project. Just how far the underground system will extend and how rapidly it will be provided has not yet appeared. It is intimated that the conduit service will extend as far south as Washington and north to Boston, taking in all the large intervening cities. A natural extension in due season would be to Chicago, taking in the cities of the Middle West from New York, and also a cross-connected trunk line from Washington westward, so that even if land slip or earthquake break one of the trunk conduits, service would still be possible around the loop. The whole enterprise is remarkable evidence of the vital part taken by telephonic communications in our national life.

CENTRAL-STATION ORGANIZATION.

The present extension of central-station service over very large areas involving the amalgamation of groups of lighting companies in a single centralized unit brings with it problems of organization which do not appear at the first glance. We do not here refer to the question of the most economical system of generation for the supply of a large area, on which we commented recently, but rather to the general conditions of central-station service, assuming for the time being at least a single great generating station. The central-station network of the kind here considered almost universally arises from the merging of small outlying stations with a large urban service. As regards the cost of energy under the new regime, there is no doubt a large and well-administered central station can put energy upon its lines and transmit it to the outlying distributing stations at a great gain in cost over anything that the outlying stations could show individually. Convert these stations into substations of a main plant and there is great and immediate saving in the cost of power production. More than this, there are incidental important gains in the general load factor, and also the improved diversity factor enters as a powerful influence for economy; for the peak loads of suburban stations would not as a rule coincide with the peak load of an urban station, nor indeed do they generally coincide closely with each other. The effect of the divers requirements even of a single group of presumably similar consumers is sometimes astonishingly large. So far, therefore, as the economy of power generation is concerned, the results of the modern amalgamated station are wonderfully good.

Much remains to be done, however, in the study of the other costs which go to make up the total expenses of a central station covering a great stretch of territory. The actual generating costs at the main plant may be down to ½ cent per kw-hour or less at the switchboard; but as every station man knows to his sorrow, these costs tell only a small part of the total story of service. The scattered service of outlying districts implies distribution costs altogether out of proportion to anything commonly found in purely city distribution, and what the effect of consolidated management is on these items is not altogether clear. Broadly, the effect upon economy should be good owing to the familiar advantages of centralized management in purchasing, distribution and efficent staff administration. A single central station serving customers over a radius of over 15 or 20 miles finds itself in many particulars handicapped by the distances to be covered and by the intricacy of the organizations between the distant consumer and the central office. It is precisely the same problem which arises in a great manufacturing establishment where it is not infrequently found that in spite of large general economies, certain of the costs run up in spite of the best efforts to keep them down to where they ought to be. This is the reason why many small manufacturers persist and succeed in spite of competition with concerns apparently big enough to swamp them with the utmost ease. In the manufacturing case the trouble is usually found in an increased amount of "back lash" due to the intricacy of the organization. The big items of material and labor may be dealt with on an economical basis, and yet the incidental and general costs of small articles may be increased all out of proportion to the apparent requirements.

Something of the same kind is liable to occur in central-

station practice on a very large scale unless there is the utmost skill and watchfulness on the part of the management. A customer on some remote portion of the circuit requires service and the practical commercial problem is to deal with him as simply and directly as possible with the minimum of general expense, vexation and delay. Just the same sort of "back lash" may occur in such a case as is common in manufacturing, unless the central-station organization is arranged very skillfully with reference to avoiding it. In all such central-station operations much depends on the management of these local affairs, and the main problem seems to be such distribution and coordination of work between the local and the general as will promote the maximum efficiency. A skillful head of a division in the central-station organization can do wonders in the way of economical administration, but he cannot spread himself out too thin, and the time comes when he has to fall back on local resources. Distribution of authority and initiative between center and periphery becomes, therefore, of very great importance in keeping down total expenses and keeping up total profits. The great central-station networks are of too recent growth to enable one to generalize on the results yet obtained, and we therefore bespeak careful study of this phase of the problem as one of the large outstanding factors in central-station development.

THE ELECTRICAL COOKING QUESTION.

As summer comes on the central-station manager revolves in his mind the various possibilities of improved load to replace the failing demand for light. Any class of consumption which will hold on well through the summer, or have its maximum in summer, is a welcome addition to the year's load; and of the possible consumers to meet this requirement, one of the largest, were the business well developed, would be the owner of the electric kitchen. As a matter of actual statistics, in spite of encouraging attempts at various forms of electrical heating, comparatively little has been accomplished, and particularly little in electrical cooking and domestic heating. Most central stations have a few bits of cooking apparatus on their circuits, just as they have a few luminous radiators, but save in isolated instances the business does not amount to very much, nor can it indeed become a considerable factor of output at the prices commonly charged. Electrical cooking devices are admirably efficient, both from the thermodynamic standpoint and from that of practical use. Most people who make the trial find the utensils extremely convenient and like them until the bills come in. At that point the electrical stove frequently gets laid upon the shelf.

The load furnished by such an equipment would be, if it could be obtained in any quantity, a very desirable one, since in the main it remains well off the peak of general load and hence puts very little burden on the distributing or generating system. In large cities the main lighting peak is, during the season of heavy load, between 4:30 and 5 o'clock, the load falling off rapidly after the latter hour. The peak is, in short, just before the end of the day's work and falls off as soon as people begin to disperse to their homes. The evening cooking peak would normally be three-quarters of an hour, or more, later, the time being fixed by the dining habits of the community—in cities nearer 7 o'clock than 6. In small places, where the interval between the time the average man leaves work and his dinner hour is less, noon dinner is rather the rule than the exception, so that again the cooking peak is pretty certain to fall well off the general peak. Furthermore, the amount of energy used in electrical cooking, although required for only a brief period, is fairly large, so that the aggregate load in kw-hours in a well-developed cooking and minor heating business is of very considerable value. Such a load implies a material addition to the suburban domestic loads, sometimes exasperatingly small so far as lighting is concerned. But it is perfectly certain that no considerable amount of electrical cooking business can be secured at lighting rates. A charge of 8 or 10 or 12 cents per kw-hour simply drives away business. If actually secured at all, cooking and heating business must be taken at rates approximating rather motor than lighting rates.

At 5 cents per kw-hour electrical cooking or heating becomes a practical matter, and at 3 cents or 4 cents should be a considerable source of profitable added load. Supplying such load on the basis of motor service is, however, no easy matter. For instance, it involves breaking away from the familiar methods of charging and may add considerably to the burden of metering if one undertakes to supply separate meters. Most popular systems of charging for electrical energy are attended with a complication that makes it particularly difficult to get business of highly specialized character. In Hartford, which is rather a hot bed of startling and profitable heresies, cooking apparatus, like domestic lighting, is taken on a contract basis with results that are reported to be rather gratifying to all parties concerned. Some other stations have tried special meters for heating and cooking service, but whatever the particular method preferred may be, the general situation is that one here has a class of load of a character quite distinct from ordinary lighting load, and approximating motor conditions. It ought to be worth getting, and some day it will so prove. At present the main difficulty is in finding a place in the scheme of charges to meet the particular requirements demanded. A scheme of primary and secondary rates skilfully adjusted, as it is in some cities, to give the consumer a chance at the secondary rate if he is a fairly liberal user of energy, will often meet the requirements; but the individual central-station manager must face this problem and solve it in his own way. The fact is, however, that in electrical cooking and heating one has a class of business that demands special treatment in the matter of rates; and the fault of most current methods of charging is that whether by statute, or by custom, or on theory, the requisite variations of rates for different classes of service are not easily applied. The result in cooking and heating, as in domestic lighting, is that the gas companies get the business of the small consumer, who individually seems trivial, but collectively is a valuable and profitable friend.

THE DANGER FROM ULTRA-VIOLET LIGHT.

An important communication to the Illuminating Engineering Society (London), from Dr. Stockhausen, deals particularly with the effects of ultra-violet rays upon the eye. The object is one to which Dr. Stockhausen has devoted much investigation and in view of the large amount of misinformation on the subject which appears to be current, we think it well worth while to devote some attention to the consideration of Dr. Stockhausen's conclusions. To begin with, the effects of radiation on the eye are very various, and the injuries produced by over

great intensity are of divers kinds, not well understood even now and often completely misunderstood. A sufficient excess of radiant energy of whatever wave length, is capable of doing serious injury to the eyes. Visible and invisible rays alike can produce disastrous effects. One cannot concentrate a large amount of energy on the delicately adjusted organs of vision without very serious risks, but beyond any doubt energy of certain wave lengths affects the eye in special ways, some of them more serious than others. Most of the popular errors regarding the whole matter come from assuming on slender evidence that certain particular rays have the monopoly of danger. Dr. Stockhausen endeavors to point out the particular physiological effects due to radiation of various wave lengths; and while the whole subject unquestionably stands in need of much more thorough experimental investigation than has yet been given, the present discussion is decidedly the most careful and apparently trustworthy that we have seen.

To begin with the infra-red and red radiations, Dr. Stockhausen points out that it is generally believed that these rays are somewhat injurious. They are, as is well known, heat rays and it is believed that their chief injurious effect on the eye is in checking the migration of the retinal pigment and in so far interfering with the adaptation of the eye and the normal distribution of the retinal purple. For this reason it has been suggested that some of the newer illuminants which produce a smaller proportion of the infra-red rays, as, for example, the tungsten lamp, represent a considerable improvement from the hygienic standpoint. This does not follow of necessity from the premises, since the important question is how much radiation of this kind it takes to produce any material interference with retinal conditions. Considering the very large absolute amount of infra-red radiation received in daylight it does not seem probable that at ordinary intensities of artificial illumination the amount of infra-red, measured in ergs per second received by the retina, is sufficient to be worthy of very serious consideration. Unquestionably the yellow-green and green-blue rays are those to which the eye is naturally adapted—that is, it is radiations of this sort which produce the maximum of luminous effect with the minimum energy spent upon the eye. It is, therefore, *a priori*, highly probable that the minimum of injurious effect is, both for this physical reason and for evolutional reasons, as well produced by these rays in the most luminous part of the spectrum. From the full blue to just beyond the end of the violet in the spectrum, light radiations, which Dr. Stockhausen regards as probably somewhat injurious perhaps from their chemical effect and partly also because they produce fluorescence of the crystalline lens, have, therefore, perhaps some slight blurring. Certainly these rays are of very small account for visual purposes by reason of their low luminosity, and whatever excess of energy they represent is mostly energy which is certainly useless and may do mischief. These rays are fortunately rather weak in most artificial light sources, are chiefly important for giving proper color balance, and to the small extent to which they are necessary for this purpose are probably sufficiently harmless.

The next group of radiations, those from the beginning of the ultraviolet to a point almost at the end of the ultraviolet in the solar spectrum, as we know it, must be regarded as possibly dangerous and desirable to avoid. They do not reach the retina to any extent because they are absorbed in the eye and particularly by the lens. They may be responsible, in Dr. Stockhausen's judgment, for inflammation of the outer eye, and they are suspected, from the very fact of their absorption, of doing gradual damage to the lens. It is a familiar fact to physiologists that as the years go by the crystalline lens assumes a yellowish tint characterized by powerful absorption of the extreme rays of the spectrum, so that elderly people are very often unable to see the violet in the solar spectrum which is perfectly visible to the young. It has been several times suggested, and Dr. Stockhausen inclines to the belief, that the cataract of old age is merely an extreme case of the photochemical changes that produce the yellow coloration of the lens in the aged. Moreover, in a recent paper it has been shown as probable that a variety of cataract found among glass workers is due to excess of radiation in the region which we are now considering.

Finally, there remains to be considered the rays in the extreme ultraviolet found in small quantity in the solar spectrum, some of them not at all, but present as powerful radiation in some artificial sources of light, as, for example, the quartz-tube, mercury-vapor lamp. It is Dr. Stockhausen's opinion that the serious deep-seated acute inflammation sometimes observed after exposure to powerful radiation is due chiefly or wholly to these extreme ultraviolet rays. Such effects are well known to have been occasioned by the quartz-tube, mercury-vapor and probably also by other forms of intense arcs capable of giving radiation of this particular sort. Certainly such injuries are not due to the group of rays which are absorbed and so never reach the retina, or to ordinary light, which, while producing serious and somewhat permanent effects, does not show itself in this violent inflammatory manner. To sum up, the infra-red rays may become injurious, but are not likely to be received in sufficient quantity. The ordinary rays in the bright part of the visible spectrum may produce serious injury when in sufficient quantity, but the mere fact that they give a maximum luminosity for minimum energy renders them the least harmful of all rays accompanying the illumination. The far blue and violet into the beginning of the ultraviolet are too weak generally to produce serious effects, but occasionally they have to be looked out for. The mid ultraviolet is suspected with some good cause of slowly producing deleterious changes in the eye and is certainly capable of producing inflammation in the outer eye. The deeper seated effects, like ophthalmia, electria and acute inflammation generally are chiefly caused by the very extreme part of the ultraviolet, and found chiefly among artificial illuminants in metallic arcs, particularly the mercury arc.

Dr. Stockhausen is responsible for the design of a particular kind of yellow-green glass very efficient in cutting off the dangerous ultraviolet rays. They are, however, stopped in great degree by many kinds of glass, some of them quite transparent for ordinary light. Three mm or 4 mm of dense flint glass, very slightly yellow in appearance, will practically block out completely all these injurious rays. A single millimeter in thickness of a darkish neutral tint glass, or any of the deeper shades of yellow glass, is equally efficient in stopping the dangerous part of the ultraviolet. A flint-glass enclosing globe 5 mm or 6 mm in thickness should stop the injurious radiations from any form of arc pretty effectively. It must not be forgotten, however, that after these rays have been stopped there is still plenty of opportunity for mischief being done for the eye by excessive radiation of any kind.

N. E. L. A. St. Louis Program.

While the final program of the St. Louis convention of the National Electric Light Association, May 23-28, has not yet been completed in all details, there will not be many additions to the list of papers given below. The meetings will consist of general and technical sessions, and also sessions of the power transmission, commercial and accounting sections.

The regular business will include President Frueauff's address and reports by standing committees as follows: Public Policy, by Mr. W. W. Freeman, chairman; Securing New Members, by Mr. H. H. Scott, chairman; Progress, by Mr. T. C. Martin, chairman; Lamps, by Mr. W. F. Wells, chairman; Overhead Line Construction, by Mr. Farley Osgood, chairman; Protection from Lightning and Other Static Disturbances, by Mr. B. E. Morrow, chairman; Uniform Accounting, by Mr. J. L. Bailey, chairman; Grounding Secondaries, by Mr. W. H. Blood, Jr., chairman; Preservative Treatment of Poles and Cross-Arms, by Mr. W. K. Vanderpoel, chairman; Meters, by Mr. G. A. Sawin, chairman; Gas Engines, by Mr. I. E. Moultrop, chairman; Question Box, by Mr. J. C. Parker, chairman; Question Box Revision, by Messrs. P. Lupke and A. J. Campbell, chairmen; Solicitors' Handbook, by Mr. A. Williams, chairman; Electrical Measurements and Values, by Dr. A. E. Kennelly, chairman; Terminology, by Mr. W. H. Gardiner, chairman; National Conservation, by Mr. D. Farrand, chairman; Insurance, by Mr. W. H. Blood, Jr., chairman.

The general and technical papers to be presented include the following: Super-Specialization, by Mr. Paul Lupke; Founding the Association, by Mr. Elmer A. Sperry; Educating the Central-Station Employee, by Prof. S. W. Ashe; Periodic Lamp Renewals, by Mr. A. G. Strickrott; Magnetite and Flaming Arcs vs. Open and Enclosed Carbon Arcs for Street Illumination (illustrated by lantern), by Mr. W. D'A. Ryan; A New Form of Tungsten Lamp, by Mr. C. F. Scott; Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis, by Mr. J. Hunter; Decentralized Steam Plants, by Mr. R. D. DeWolf; Space Economy of Turbo-Generators, by Mr. Paul M. Lincoln; Gas-Engine Plants for Central Stations, by Mr. Nesbit Latta; Feeder Regulators, by Mr. E. E. Lehr; A New Departure in Distribution Construction Methods, by Mr. S. B. Way; Direct-Current Turbo-Generators, by Mr. W. L. Waters; Location of Faults in Underground Cables, by Mr. W. A. Durgin; Interesting Points About Modern Transformers, by Mr. E. J. Reed; Precautions When Using Instrument Transformers, by Mr. L. T. Robinson; Comparison of European and American Switchboard Practice, by Mr. S. Q. Hayes; The Oscillograph in Fuse Testing, by Mr. Alex. Maxwell; Small Hydraulic Plant Design, by Mr. F. J. Howes; Irrigation in Rural Communities, by Mr. H. Russell; The Series Tungsten Lamp as a Factor in Street Lighting, by Mr. C. E. Stephens; The Voltage Control of Generators and Feeder Systems, by Mr. F. W. Shackelford; The High-Efficiency Lamp, by Mr. S. E. Doane. A special address will be given on Anniversary Evening by Past-President Insull on "Twenty-five Years of Central-Station Commercial Development."

The Power Transmission Section, with Mr. D. B. Rushmore as organizing chairman, has not yet fully formulated its program, but a general committee of some 30 well-known engineers is now at work. Among papers and addresses are the following: The Public and the Water-Powers, by Mr. H. L. Doherty; Present Problems in Power Transmission, by Mr. H. W. Buck; Phenomena of Power Transmission at Highest Voltages, by Dr. C. P. Steinmetz; Modern Power Transmission Systems, by Mr. C. F. Scott. Several important topical discussions are being arranged.

The program of the Commercial Section includes the following papers: Latitude in Commercialism, by Mr. Arthur S. Huey; Residence Lighting, by Mr. H. J. Gille; Central-Station Advertising, by Messrs. H. K. Mohr and C. W. Lee; Electric Automobiles, by Mr. Hayden Eames; Ornamental Street Lighting (illustrated by lantern), by Mr. E. L. Elliott; Sales Department Organization, by Mr. T. I. Jones; A Plant to Interest National Advertisers in Electrical Publicity, by Mr. Frank B. Rae, Jr.; Industrial Lighting with Incandescent Lamps (illustrated by lantern), by Messrs. J. M. Hoit, S. H. Hall and Paul Bauder; Prompt Execution of Orders, by Mr. Clare N. Stannard. Several prominent men have promised to open the various discussions.

The Accounting Section will present papers as below and the Committee on Uniform Accounting will exhibit a series of nearly 20 large books, embracing thousands of classified forms and blanks sent in by about 150 member companies. The titles of papers are as follows: The Accounting Methods of the Detroit Edison Properties, by Mr. E. J. Bowers; Storeroom Accounting, by Mr. R. F. Pack; Electrical Current Stock—How Calculated; Mechanical Office Appliances; Handling Customers' Line Orders; Voucher and Accounts Payable Record; Meter Records; Care and Handling of Customers' Accounts, by Mr. J. M. Mulvihill; Statistics of an Electrical Corporation; Clerical Routine Involved in Connecting Customers; Job or Work Order System.

In addition to the exhibit above referred to, of the committee on uniform accounting, there will also be special exhibits by the Meter and Question Box committees. It is also proposed to arrange an "experience meeting" for the score or more of company sections, at which section work will be discussed and data will be submitted as to the rules and regulations for the award of the gold medal offered by Past-President Henry L. Doherty for the best paper read before company sections during any year.

Exhibits will be received at the Coliseum Saturday morning, May 21 at 8 o'clock. Under arrangements made with the St. Louis Transfer Company, shipments may be made at any time, their charges including storage to the time of the convention. Sixty-cycle—115/230-volt alternating and 115/230-volt direct-current electrical energy will be available for the operation of exhibits, which will be supplied by the Union Electric Light & Power Company without cost to the exhibitors. Telephones will be supplied in the booths of exhibitors at $3.50 per instrument, this price including unlimited local service. It has been arranged to run mains at the back of every booth, that exhibitors desiring energy for the operation of their exhibits may obtain connections at the lowest possible cost. The distribution of souvenirs, as well as the distribution of advertising literature or papers of any description on the chairs in the convention halls is also prohibited.

Annual Report of General Electric Company.

The annual report of the General Electric Company, issued under date of April 15, covers 11 months ending Dec. 31, 1909. Previously the fiscal year of the company ended Jan. 31, but to meet the requirements of the federal corporation tax law it was changed to end Dec. 31.

The total sales billed for the 11 months were $51,656,631, or at the rate of $56,352,686 for 12 months, as compared with $44,540,676 for the previous year. The orders received during the past year were 89.9 per cent of those received in the year ending Jan. 31, 1907, the record year, and were 128.8 per cent of those received in the year ending Jan. 31, 1909. The orders received the last five months of the year were at the annual rate of $69,670,000. The total number of separate orders and contracts during the 11 months was 270,659, as compared with 248,384 for the preceding 12 months. The average value per order was 20 per cent larger than for the previous year.

The profits of the company for the 11 months were $6,493,670, including $478,019 from securities sold, and $1,260,847 from royalties, dividends, interest, etc. Dividends paid, including that of Jan. 15, 1910, were $5,214,352, leaving a surplus for the 11 months of $1,279,318. A somewhat larger percentage was written off for factory plants than in previous years, due to the fact that a greater proportion than usual of the year's extensions to plant was for other than strictly productive purposes, such as real estate, storage warehouses, etc.

President Coffin in his report states that considerable sums were expended during the year in acquiring United States patents on foreign inventions relating to incandescent lamps and processes of manufacture, by which the company expects to maintain its high position in this branch of the business. The capacity of many departments of the factories, he says, is still considerably in excess of the present rate of production, and factory facilities cannot be fully employed until the volume of orders received is considerably increased.

Percentages relating to terms of payment secured during the year were as follows: On shipment, 16.9; 30 days, 69.1; 60 days, 6.5; 90 days, 2.4; over 90 days, 5.1. During the year there was expended in acquiring patents, for costs of applications and licenses under patents, patent litigation and miscellaneous expenses, $904,207.34, which amount was charged to profit and loss, leaving the company's patents, franchises and good will standing at the nominal value of $1, as previously. The cost of additions to factory plants during the year was $2,878,942, and the amount written off at the end of the year on this account was $2,447,984. The total cost to date of the factory plants has been $40,254,251, but owing to the large sums written off at the end of each year during the past 17 years, the book value on Dec. 31, 1909, was only $14,330,958.

The company had invested at the end of the year $3,048,604 in mining and milling properties; in stocks and bonds of affiliated companies, $5,604,527; in stocks and bonds of the United Electric Securities Company, Electrical Securities Corporation and Electric Bond & Share Company, $6,262,397; in stocks and bonds of local lighting and railway companies, $3,598,368; in miscellaneous stocks and bonds, $3,553,753; in stocks and bonds of sundry foreign corporations, $3,310,615. The machinery inventories were $25,150,035. During the year stocks and bonds were sold for cash to the amount of $1,601,475, which had been carried on the books at $1,123,455. The liabilities include debentures to the value of $14,,962,000, and capital stock of $65,-179,600.

A list is given of 14 electric railway companies to which 1200-volt motors have been sold. More than 66,000-hp of such motors are in operation and on order. It is stated that the Curtis steam turbine is installed in more than 650 central distributing stations and power plants throughout the world, with a total capacity in excess of 1,750,000 hp. The low and mixed pressure turbines are stated to have proved most economical and satisfactory in operation; the New York Interborough Company has now installed three low-pressure turbines of 10,000 hp each, and has ordered two additional units of the same size and type. Many contracts for similar turbines of various sizes have been received, and the outlook for a rapid extension of business in this direction is pronounced to be very promising.

The incandescent lamp business is said to show a substantial increase over the previous year. Reference is made to the adoption of the trade name "Mazda" as indicative of the most recent and important developments in high-efficiency metallic-filament lamps.

In noting the factory plants erected during the year, it is said that the policy of decentralization has been continued with most satisfactory results. The total amount of unexpended appropriations on buildings under construction and appropriations made for enlargements during the year is approximately $2,300,000.

The report states that a number of engineers have been selected to specialize on various industrial power applications, such as will be found in the operation of paper, cement and cotton mills, printing presses, machine tool drives, etc., who will give careful study to the problems that arise in connection with the electrification of such industries, and advise and co-operate with customers. The line of mining locomotives has been redesigned and greatly improved during the year. A new electrolytic lightning arrester has been further developed and improved. Engineers at present are engaged in the development of turbo-generators of a capacity of 20,000 kw each, and the line of improved horizontal turbines has been greatly extended.

Banking Organization for Financing Public Utilities.

The Public Securities Company has been organized under the laws of New Jersey, with authorized capital of $20,000,000, to finance public utilities, or, more broadly, "creative enterprises," in the Middle West. The purposes of the company are to purchase or underwrite entire issues of bonds, to carry entire issues of bonds on a profit-participating basis, to conduct a wholesale business in bonds and investment securities, and to undertake the financing of gas, electric, traction, steam-railroad, hydroelectric, irrigation and other projects. It is asserted that the proper channel for such financial undertakings is through a corporation with large capital, carrying no demand liabilities. The financing of public-service companies will only be undertaken after an exhaustive investigation by the officers, engineers, attorneys and experts of the Public Securities Company. The principal center of activities of the company will be in Chicago. The company owns and controls McCoy & Company, retail dealers in bonds, and Mr. Homer W. McCoy is president of the Public Securities Company, the other officers being Messrs. Charles H. Deppe and Walter A. Graff, vice-presidents, and Joseph H. Roy, secretary and treasurer.

The board of directors consists of 17 gentlemen, the majority living in Chicago. In addition to the officers named, there are several directors well known in the electrical field, including H. M. Byllesby, president of H. M. Byllesby & Company; Samuel Insull, president Commonwealth Edison Company; Thomas E. Mitten, president Chicago City Railway Company, and Bernard E. Sunny, president Chicago Telephone Company. Mr. E. G. Cowdery, vice-president of the People's Gas Light & Coke Company, of Chicago, is also one of the directors. The others are business men of prominence. In addition, there is an advisory board of 30 members, consisting principally of presidents and other officers of banks and trust companies scattered throughout the West and South.

The $20,000,000 of capital stock is divided into $10,000,000 of first preferred, $2,000,000 of second preferred, and $8,000,000 of common stock. The first preferred carries a dividend of 7 per cent and is redeemable at any time after three years from date of issue at $110 a share. The second preferred and common shares do not receive any stated dividend but the surplus earnings of the corporation, after the payment of the dividend on the first preferred stock, except the amount, if any, reserved for working capital, is payable one-half to the owners of the second preferred shares and the other half to the owners of the common shares. All classes of stock have voting rights, but to insure stability of management and control, the second preferred shares have preference over the other classes of stock in electing the majority of the board of directors. The first preferred stock is offered at par, with a bonus of common stock equal to 40 per cent of the subscription. Offices of the company are at 181 La Salle Street, Chicago.

Agricultural Implement Manufacturer Attacks U. S. Patent System.

Mr. William Fetzer, a Springfield, Ill., plow manufacturer, has made public a letter written to President Taft in which the United States patent system is vigorously attacked. He said that while in 1909 $1,309,735 was paid to the Patent Office for 37,421 patents, and as much again and more paid to attorneys, the issue of 99½ per cent of these patents indirectly involved fraud on inventors. Of farm machinery patents that are issued not more than 5 per cent are ever actually applied; not more than 2 per cent go permanently into manufactures put on the market; not more than 1 per cent are tested out in the Federal courts, and of these latter hardly one-half are upheld by the Government which granted and issued the patents. The writer relates that, finding patents issued to him were being flagrantly infringed, he was finally driven to commence suit against a competitor upon one which appeared the strongest of a large number of his inventions supposedly protected by patents. He has found, however, that the defense

was taken over by the agricultural machinery trust, which furnished its chief patent counsel to take charge of the case, and one of the largest component companies sent its officers to testify against the patent. Moreover, he states that the plow combination threatened to destroy his other patents unless the present suit is withdrawn. The only real protection the Patent Office now grants is, he said, the protection of the lawyers in their fees. A lawyer, he says, may agree in writing to take an inventor's patent application through to issue for $50, then subsequently demand $50 more and refuse to allow the issue of the patent until this amount is paid, in which refusal the Patent Office will sustain him. The Patent Office does not, he says, afford the inventor any recourse against lawyers' dishonesty. "Whereas," he asserts, "our forefathers originally intended the patent department as a protection and blessing to the young men of industry, it gradually has been changed into a hog trough for the liberal feeding of low-grade lawyers who are being upheld to gold-brick the inventor." Mr. Fetzer adds that he does not wish in any way to reflect upon the examiners or officials of the Patent Office, whom he has always found to be capable and thoroughly honest, and seeming to have nearly as much interest in their work as if they owned the department. The difficulty is in the intervention of the courts, and he advocated that exclusive control and disposition of patent matters, including all patent litigation, be confined to the Patent Office.

Chicago Elevated Railways.

The Chicago Elevated Railway Commission is considering five plans to solve the problem of through-routing of elevated trains in that city. Thirty-eight plans were submitted to the commission, and five of these were selected for more careful study. The most radical of the plans presented would necessitate the erection of an elevated-railway structure on State Street, but this will hardly be permitted.

Mr. B. J. Arnold, who is chairman of the commission, feels that progress has been made in narrowing down the work. It is pointed out that each of the four elevated-railway companies is operating under a separate ordinance granted by the city, and that the interrelation of the elevated lines is caused by the joint use of the "downtown" Union Loop. The companies are doubtful whether they can afford to haul passengers for a greater distance than about six miles for 5 cents, but there is apparently a desire on the part of everybody concerned to reach a solution of the question if possible.

The commission consists of the Mayor and the chairman of the City Council transportation committee, as well as Mr. Arnold and the presidents and engineers of each of the elevated-railway companies. Engineers from the Board of Supervising Engineers are also members.

Meanwhile, the plan for merging the elevated-railway companies has been revived, and it is said that Mr. Henry A. Blair has taken the subject up. The new plan is said not to involve an increase of capitalization, but nothing definite has been decided upon in relation to it.

Advanced Study of Electrical Engineering at Massachusetts Institute of Technology.

Some interesting facts are being brought out by investigations of the effect of high voltages on insulating material by Mr. H. S. Osborne, who is carrying out work for the degree of Doctor of Engineering at the Massachusetts Institute of Technology. At a recent meeting of the Boston Section of the American Institute of Electrical Engineers, which was held at the electrical engineering laboratories of the Institute of Technology, Mr. Osborne lectured on the results of his experimental research. He briefly presented the results in an interesting and effective manner and set forth theories of the effect of high voltage on insulating materials which are in closer harmony with experimental facts than the theories usually stated. This year the Institute will confer for the first time the degree of Doctor of Engineering in course. The Institute has heretofore given a good many second degrees for advanced study in engineering, and a few degrees of Doctor of Philosophy to students who have pursued advanced study in chemistry and other more general sciences, but it has not heretofore conferred a Doctor's degree on a student for extended advanced study of engineering.

The lectures of Prof. Harold Pender for graduate students will next year extend the discussion contained in his advanced lectures of this year on the high-voltage alternating transmission and utilization of power. The general treatment of the transmission circuit contained in his lectures of this year will be repeated and extended and more attention will be given to the conditions arising from the utilization of the power.

Professor Jackson's lectures for graduate students on the organization and administration of public-service companies have this year dealt more particularly with questions of value of plant, the theory of so-called intangible values, the relation of revenues to value of the plant, depreciation, and the like; and next year the lectures will be directed more to the theory underlying methods of charging for service by public service companies, with particular reference to charges for electric light and power, but with collateral consideration of railroad and tramway charges and charges for gas and the service of other public utilities.

Professor Wickenden will originate a course of lectures on illumination, photometry and illuminating engineering which will become a part of the optional curriculum for undergraduate and graduate students.

Underwriters' Requirements in Relation to Low-Voltage Transformers and Economy Coils.

Much interest exists at the present time in relation to the underwriters' attitude toward the installation of low-voltage transformers and economy coils, and also toward the subject of low-voltage general and sign lighting—a field apparently capable of wide expansion—as the result of the advent of the tungsten lamp. The situation is one of great interest both to electrical men and to the underwriters and municipal electrical inspectors throughout the country. An informal meeting of representatives of the Underwriters' Laboratories, the National Board of Underwriters, the National Electric Lamp Association, the electrical inspection department of the city of Chicago and the Chicago Board of Underwriters was held in Chicago on April 25 to consider this subject.

No definite and final action was taken, but some suggestions were put in shape to be submitted to the committee of the National Board of Underwriters for approval and relating to the installation of low-voltage transformers and economy coils. These suggestions may or may not be adopted by the committee, but it appears likely that the rules which will later be adopted on this subject will be based on them, to some extent at least.

It was the concensus of opinion at the Chicago meeting that the electrical fire hazard would be increased if lower voltages than 55 were adopted, on account of the larger currents used. All fittings rated at 250 volts have capacities sufficient to carry 55-volt currents with safety, but this is the maximum limit. With 55 volts ordinary drop cord and fixture wire might be slightly overloaded, depending upon the number of lamps on the fixture. It was suggested that low-voltage transformers and economy coils need not be enclosed if they are of the approved air-cooled type properly mounted. They must have a primary fuse with carrying capacity equivalent to the rating of the device. Secondaries must be protected with fuses no greater than 12-amp capacity. All other wiring must be in accordance with the rules of the National Electrical Code.

As indicated above, the subject is still under discussion, and low-voltage installations and series wiring for signs will be taken up at a future date.

Episodes in Electrical Invention and Patent Litigation

Addressing the Electric Club on April 27, Mr. Charles A. Brown, of the Chicago patent bar, gave some interesting reminiscences of his years of experience with electrical inventions and patent contentions. He spoke of Edison's invention of the duplex telegraph system and related the story of the inventor's negotiations with Mr. Orton, then president of the Western Union Telegraph Company. Mr. Orton tried to impress on Edison that his invention was not very different from the Stearns duplex. Edison's laconic rejoinder was, "But mine works."

Another story related to the "expert relay" of S. D. Field. In explaining to the patent examiner this unusual title for an invention, Mr. Field said: "I call my relay an 'expert relay' because it has a tongue adapted to lie on either side with equal facility, according to the influences brought to bear upon it."

The development of the telephone is probably the most dramatic thing in the history of electrical invention, and it resulted in the greatest patent case ever brought in the courts. Mr. Brown told some interesting anecdotes about the Drawbaugh claims, and paid a high tribute to the late James J. Storrow, in those days chief patent counsel to the Bell Telephone Company. The Edison lamp patent was also referred to, and the interesting manner in which the Goebel defense was exploited.

Speaking of the Thomson-Houston regulator patent, Mr. Brown told of the elaborate preparations in court to demonstrate the working of the invention. Apparatus valued at $10,000 was set up in a room adjoining the court, but on the trial the judge's time was entirely taken up with the argument, and he never looked at the apparatus.

The Edison compound-wound dynamo case was another in which there was an elaborate demonstration. Here, however, a very effectual use was made of the exhibit. The defense was the work of Brush on his plating dynamo, and the effective regulation of the Brush construction was shown by the apparatus exhibited for the court's inspection.

Passing to the rotating field invention, Mr. Brown said that there was no doubt that Ferraris was the earliest inventor of the rotating field, but in this country, independently, both Tesla and Shallenberger made the same invention. The work of Shallenberger anticipated that of Tesla, but all three of the men named were independent inventors. Legal technicalities, he said, gave Tesla the award of the invention in this country. Mr. Shallenberger, who was a graduate of the U. S. Naval Academy, possessed, he added, one of the best minds ever employed on electrical work in the United States.

Mr. Brown's address was an unusually interesting one, and after a brief discussion by Messrs. F. S. Hickok, F. P. Vose and H. E. Niesz a vote of thanks was extended to the speaker.

Water-Wheel Testing.

A joint meeting of the Boston Sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers was held on the evening of April 27, when Prof. C. M. Allen, of the Worcester Polytechnic Institute presented a paper upon "The Testing of Water-Wheels After Installation," and exhibited a large number of lantern slides showing the Alden absorption dynamometer installed in power plants for testing service. Within the past few years there has been a growing demand for brake tests of water-wheels after installation, the object being to determine the horse-power output and in many cases the efficiency of the wheels under actual running conditions, as well as to ascertain whether the wheels are up to their guaranteed rating. Professor Allen stated that the Holyoke testing flume has done much good in connection with water-wheel design, but that it was not planned to test high-head or the largest modern turbines. If a wheel is not set properly and is run too fast, which seems to be the almost universal practice, it will fall down on both power and efficiency, the drop depending upon the departure from normal conditions. Water-wheel efficiency has a direct bearing on the conservation of natural resources. In the case of several typical hydroelectric installations the cost of power house, dam, reservoirs, generators, transmission lines, etc., is over 90 per cent of the total, leaving less than 10 per cent for the wheels; but upon the latter depends to a large extent the income from the entire installation, as well as a probable saving in fuel somewhere.

Professor Allen contended that the brake test is simpler than the electrical test of wheel efficiency and more readily accepted by different manufacturing interests. He emphasized the necessity of careful instrumental calibration and reading in electrical testing, and described at some length the Alden absorption dynamometer, which is a form of Prony brake that has been used for several years in this work. The friction between revolving disks and copper plates working under water or oil pressure absorbs the energy, which is measured by transmitting the pull upon the dynamometer to suitable platform scales, taken in connection with observed speeds. No additional load is put upon the wheel bearings on account of the use of the dynamometer. The largest dynamometer built at present consists of four 60-in. disks and has a capacity of about 3000 hp at 200 r.p.m. A cheap grade of cylinder oil has been found satisfactory, but a system of forced lubrication is necessary to smooth operation. A recent improvement which increases the capacity is the use of electro-copper-plated sheets in place of plain rolled copper. Tests showed that the gain in heat-absorbing power was 30.8 per cent, the copper-plated sheets absorbing 610 lb.-Fahr. heat units per square foot per minute per 50 deg. difference in the temperature of circulating water compared with 467 heat units with the plain copper. A probable explanation is that when the sheets are plated the copper is deposited in small globules, and the actual surface is both increased and roughened, tending to mix the water currents and bring more water or oil in contact with the copper. The forced lubrication enables tests of any length to be made.

Besides tests in pulp mills, several tests of large powers have been made in hydroelectric stations, in which case the generators are set aside and the dynamometer mounted on the wheel shaft, usually in place of the half coupling. In one plant the test showed that the wheels were giving their contract rating, but that if they had been run at 200 r.p.m. instead of 225 r.p.m. the power would have been increased from 2000 hp to 2300 hp, showing a waste of 300 hp and a decided loss in efficiency. On another test it was found that when the wheels were running at the guaranteed speed, the power and efficiency were between 30 per cent and 40 per cent lower than normal. Removing the entire load only slightly increased the speed. If wheels are given a fair setting they will agree closely with the computed ratings made from the tests at Holyoke. Fair setting means that the water should be brought to the wheel with a low velocity; the draft tube should be specially designed for the conditions and should be air-tight; the wheels, if a pair, should be center discharging, and not too close together; if a pair and outward discharging, end supply should be avoided if a steel penstock is used; the shaft should not be longer than necessary, and the bearings should be kept in line. This setting refers to open-flumes or steel penstocks and not spiral casings.

The author then discussed losses in bevel gears, and cited tests to show that these are often much exaggerated. With properly designed and installed gears, well lubricated and not overloaded continuously or left to care for themselves the efficiency should be from 95 per cent to 97 per cent. The dynamometer has shown, to cite a single case, that a wood-mortised bevel-gear meshing with a planed tooth cast-iron pinion transmitting 700 hp between a vertical turbine shaft and a horizontal generator shaft, operated at an efficiency of 96.5 per cent. The gears were lubricated with thick grease. In conclusion the paper presented curves of wheel efficiency and illustrated the evils of poor setting.

DISCUSSION.

Mr. R. A. Hale pointed out that high velocity in the penstock, small wheel casings and obstructions in discharges are sources of loss. The proper design of draft tubes is most important, notably in the enlargement of area and making the angular direction of the tube in line with the current. In gen-

eral, the inclination should be not over 45 deg. The outlet should be deep enough to avoid air. Elliptical outlets render deep excavation less necessary. A current meter attached to a pole gives better results than on a wire or rope. Vacuum gages are helpful in studying draft tube conditions.

Mr. J. C. Parker, Rochester Railway & Light Company, emphasized the value of tests on the ground. By them one can check whether the runners are deteriorating enough with invisible wear to cut down the efficiency. He did not agree with Professor Allen in regard to electrical testing, but thought that the latter is an admirable method of analysis. In a test just completed on three 16,000-hp turbo-alternators the load was absorbed readily by water rheostats; the machines were separately excited, and the operating force of the company was dependable. The losses in the alternators were not over 1.5 per cent, and with smaller machines would not be over 2 per cent or 3 per cent at full load. These losses are determinable, whether in the armature copper, iron, windage or friction wastes. The only vitally necessary instruments are polyphase recording wattmeters, ammeters and voltmeters being used only for checks. When things go wrong on an electrical test it is only necessary to close the gates. Mr. Parker said that the design of housings and draft tubes has a powerful effect on turbine efficiency. In his opinion American practice is behind European in this respect. The old barrel type of housing is execrable, since it asks the water to change its direction of flow, turn right-angled corners, and change in velocity without loss in efficiency. Prof. Dwight Porter, Massachusetts Institute of Technology, commended Professor Allen's work in the field, and touched upon the value of such tests to the turbine manufacturer and the user of energy. In the field the velocity and the head are not in close theoretical relations, and draft-tube losses are uncertain. The error may be small in per cent, but large in actual quantity of power. Prof. George E. Russell, of the same institution, said that the lack of systematic testing after installation has hampered design. Prof. H. K. Barrows pointed out that electrical tests are necessary on large spiral-cased wheels which cannot readily be handled by brake tests.

Electrification of Boston Railroads.

At a recent legislative hearing in Boston upon the various bills providing for the compulsory electrification of the railroads of the metropolitan district, counsel for the steam roads emphasized the cost of eliminating the steam locomotive and collateral improvements for the purpose of showing that the burden of such changes upon their clients would be prohibitive. It was argued that the principle benefit to the public would arise from the elimination of the smoke nuisance, and that the status of electrification at the present time is not sufficiently established to warrant legislation forcing the companies to undertake the work. At a subsequent hearing before the committee on metropolitan affairs, which has the electrification question in hand at this session, the advocates of electrification presented a vigorous rejoinder in the form of an extended discussion from the standpoint of the engineering expert. Mr. Hollis French presented a trenchant argument for the establishment of electrical service, based upon an extended personal examination of the terminal installation at New York and numerous interviews with officials in immediate touch with electrified service.

Mr. French stated that it is most important to differentiate between expenditures for electrification *per se* and for the collateral expenditures, owing to the fact that these latter may under some circumstances be as great or greater than the cost of changes in motive power. The cost of electrification itself is made up of only those items dependent on the use of electricity, such as power stations, third-rail, if used, conductors, track bonding, electric locomotives, multiple-unit rolling stock, buildings for the same, changes in signals, etc. Collateral expenditures comprise such matters as double-decking terminals, abolishing grade crossings, additional trackage, changes in grades, tunnels, approaches, etc. These are not all properly chargeable to electrification cost, for many of them are required as a matter of public policy, or to take care of growing traffic, and hence are apart from a change in motive power. That many of them are possible only by the use of electricity is really an argument for the latter, and that the others increase the earning power of the road is sufficient justification. The wisdom of making these great collateral changes must rest either upon the development of traffic or be required by public policy. It is proper, therefore, to set against the cost of electrification only those changes made necessary by the modification of motive power alone.

An extended review of the existing systems of electrified service in this country was then given, special emphasis being laid upon the work of the New York Central, New Haven, Long Island, Pennsylvania, West Jersey & Sea Shore, West Shore, Baltimore & Ohio, North Shore of California, Grand Trunk, Great Northern, Erie, Washington, Baltimore & Annapolis, Baltime & Annapolis Short Line and Inland Empire system, with passing mention of the principal installations in England, France, Switzerland, Germany and Prussia. The point was made that in spite of the fears of the public regarding the use of an 11,000-volt service by the New Haven company, not a single one of the public has been killed during the years of operation of this system by reason of the high voltage used, and still further line improvements are under way.

Mr. French contended that it is now possible to make reasonably close estimates as to the cost of electrification, although the question must be approached with due care to avoid premature conclusions. Without thorough analysis of the conditions, incorrect deductions must inevitably be drawn. It is generally believed that the New Haven expended about $5,500,000 on its work between Woodlawn and Stamford, comprising, roughly, about 100 miles of line reckoned as single track. This would be figured approximately at $55,000 per mile. It is thought that the New York Central on about the same length of track expended about $12,000,000, or roughly $120,000 per mile. Conclusions drawn from these rough mileage costs can only be misleading. To compare satisfactorily the figures one would have to take account of the fact that the New Haven work involved little terminal expense, being done on straight-away track branching from the New York Central line outside the city, while the Central electrification included enormous expenses connected with the changes in the Grand Central terminal and a duplicate power equipment, in addition to many other expenses not required in the New Haven work. The fact that there may be perhaps 600 miles of track to be electrified in the Boston district does not mean that the cost would be $33,000,000 if the New Haven system were adopted, or $72,000,000 on the basis of the New York Central system. The figures are simply not applicable in that form. It is probable that the expense of electrification within a 10-mile zone at Boston would be between $40,000,000 and $50,000,000.

Improvements in the equipment of both systems will reduce the unit prices. Mr. French stated that it is most probable that the single-phase system will be adopted for most of the Boston lines, since the bulk of the mileage is controlled by the New Haven company. A uniform system for all roads would result in simplicity, interchangeability and economy. It is, however, possible to have the two systems in Boston as in New York. Mr. French then emphasized the advantages of smoke, dirt and noise abolition or reduction, improvement in the life of steel structures, possible saving in fire loss, independence of the service regarding the weather, increased comfort of riding, improved safety of operation due to unobscured signals, provision for emergency stoppage of service, improvement in property values, double-decking of yards for commercial purposes and shortening of the time of transit between suburban and city points, all coincident with electrification.

The improvement in convenience and operating economy of an electrically equipped tunnel between the North and South stations was pointed out, and the economies of electric traction to the railroads themselves were emphasized. The State lines expended about $12,000,000 last year for coal, or 15 per cent of

their gross expenses. Electricity, if completely carried out, would save fully 50 per cent of this fuel consumption. It is estimated that the saving in fuel on the present electrified section of the New Haven will be about $340,000, or 6 per cent on the supposed cost of the installation. It is believed that the cost of repairs and maintenance for electric locomotives will be about 2.5 cents per locomotive-mile, making a saving of $196,000 per year on the present electrified section of the New Haven, or between 3 per cent and 4 per cent of the total supposed cost of electrification. More work can be done per locomotive with electricity. Multiple-unit surburban trains save in labor costs. Owing to the improved number of trains and increased number of trains possible with electricity, it is not likely that the change in motive power will throw many men out of employment. The delays will be reduced; the New York Central having found that the delays have been cut down from 2 minutes to 1.2 minutes per 1000 train-miles, with an equally good record on the New Haven, which means actual economy to the companies.

In conclusion Mr. French pointed out the increase of traffic which follows electrification. The trolley lines have developed an immense business which electrification will in part restore to the railroads, besides developing new territory and thus increasing patronage. The Manhattan Elevated of New York showed under electricity a decrease of 20 per cent in the car-mile cost and an increase of 48 per cent in speed. The Oak Park, of Chicago, showed 8.2 per cent decrease in cost of operation and 20 per cent speed increase. The South Side, of Chicago, had a 16 per cent decrease in cost and 14 per cent increase in speed, and the Metropolitan, of Chicago, showed 15 per cent decrease in cost and 28 per cent increase in speed in the eleventh year of operation when wages and coal costs were higher than in steam practice. The Mersey line out of Liverpool increased its passengers from 3,200,000 to 4,500,000 in the first six months after electrification. The Lancashire & Yorkshire increased by over 100,000 passengers per month. The Milan-Gallarate receipts rose from 663,000 lire to 993,150 lire with electricity, and the West Jersey & Seashore increased 20 per cent the first year with electricity compared with less than 2 per cent the year previous under steam. Mr. French closed with the statement that the saving of $546,000 in fuel and locomotive repairs on the electrified section of the New Haven warrants the belief that the railroads could expect generous subscriptions to new capital issues for electrification. The money will not have to be raised at one time, but will be extended over a possible five-year period, making the share of each road per year not an unreasonable burden. It would seem as if the financial difficulties had been exaggerated.

Electric Turntable Service.

At the last convention of the American Railway Bridge and Building Association, held in Jacksonville, Fla., an important committee report was submitted on the subject of turntables. Opinions were presented from a large number of railroad officers covering questions of design and cost, and a general tendency toward the use of electricity in turntable driving was noted. In view of the advantages of this class of service to central stations in search of off-peak power loads, the following extracts from the reports bearing upon electric turntable operation are printed:

Mr. H. A. Horning, Michigan Central Railroad, stated that if possible an electric turning device should be supplied. If electricity is not available, gasoline is the next best motive power. The current for operating the table should be brought in beneath the pit and the table should be well lighted. Mr. A. H. Beard, Philadelphia & Reading Railway, stated that an electric motor drive will shortly be placed in service instead of a gasoline engine on a 65-ft. plate-girder table at the Reading round house. The cost of operation with gasoline is $165 per month, including labor, oil, fuel and repairs. About 80 engines are turned daily, and it is expected that electric operation will result in decided economies over gasoline.

Mr. W. T. Mains, Chicago & Northwestern Railway, cited the use of a 70-ft. table operated by a 10-hp motor upon which 400 locomotives were turned in every 24 hours. The cost of the table equipped was about $5,000. Mr. Main advised the use of an electric motor for operating tables wherever possible, and especially in locations where very rapid turning is required, as in congested urban districts and important division points where locomotives must be handled with maximum speed. Compressed air gives good service where there is plenty of time for handling engines, and where there is a sufficient supply of air which can be piped to reservoirs, but it is slow in operation in cases where the engine itself must supply the air for turning.

Mr. J. B. Sweatt, contractor, Boone, Ia., contended that where electric power can be obtained at a reasonable rate an electric motor should be used, as it is not necessary to have an experienced man to run it, and the cost of operating will be very small as compared with the loss of time of roundhouse men, extra help, and the saving of time in turning. Mr. A. O. Cunningham, Wabash Railroad, said that electricity is ideal for turntable operation. He gave the cost of the electrical equipment as about $1,150, and that of a gasoline-engine outfit for the same service as $1,000. Mr. A. Montzheimer, Lake Shore & Eastern Railway, cited the use of a 70-ft. table at Gary, Ind., of the Pratt girder type, driven by a 45-hp motor. The girders are hinged at the center so that the ends of the table take their own share of the load.

Mr. W. F. Strouse, Baltimore & Ohio Railroad, stated that the cost of each of the two 80-ft. plate-girder turntables installed under favorable conditions was $7,950. The bearing capacity of the soil was such as to require no unusual foundations. The cost of the electric driving mechanism, in place, included in the above, was $1,360 in each instance. The electric tractors were of the Nichols type and each consisted of an operator's cabin of structural steel framing, in which is located an electric motor geared to the shaft upon which the traversing wheel is mounted. The operator's cabin is attached to the table by a pin forming a flexible connection. The tractive effort of the traversing wheel depends upon the weight of the cabin and motor and gears contained in it. The motors in the tables, whose costs were given, are rated at 10 hp each.

These opinions expressed by railroad officers in immediate touch with turntable operation and design deserve notice by central-station power solicitors. The work is distinctly of the off-peak variety, and in many cases extends over many hours of the day and night. In large installations, where 200 or 300 locomotives have to be turned every 24 hours, there is a demand for electric power at least every seven minutes on the average. The power demand lasts steadily for a sufficient number of seconds to produce an energy consumption well worth while in the course of a month. The size of the motors installed is advantageous to the central station, and the rapid acceleration, quickness of control and compactness of the electric tractor render it far superior to other motive powers. On account of the extension of this service throughout the entire day and night a central station can well afford to make a rate which will gain this business. In a large city the roundhouses are scattered and their periods of operation are variable. This tends to produce a good load factor upon the distribution system, and makes the operation of turntables by electricity a profitable source of revenue.

The Electric Vehicle and the Central Station.

The regular monthly meeting of the Electric Vehicle & Central-Station Association was held at the Edison Building, Boston, on the evening of April 29. Former President Frank J. Stone, who was in the chair in the absence of President W. H. Blood, Jr., called attention to the encouraging fact that the renewals of membership at the end of the association's first year showed no falling off in numbers. The first speaker of the evening was Mr. Howard S. Knowlton, who read a paper entitled "Side Lights on the Electric Vehicle Situation." The author emphasized the plans of guaranteed costs and service upon which the electric vehicle to-day stands, and pointed out

that economic forces of overwhelming power will in time drive the horse from his present absurd position in the machinery of commerce. It is inconceivable that mere muscular power can remain a commercial competitor of the electric motor. If the central station knows its business and if the manufacturers of electric vehicle equipment play fair with each other in open competition and apply their products upon the basis of an adequate engineering investigation of each specific proposition it will be only a few years before the horse will be a scarcity in industrial transportation over tolerable roads within reach of central-station charging facilities.

The electric vehicle industry is already taking advantage of scientific analyses of conditions surrounding the design and service of railway motors. Improvements in design of batteries and methods of maintenance are no less important, but apart from the details of apparatus, stands out the compelling fact that the equipment now on the market can be counted upon week in and week out to handle its loads more rapidly than is possible with animal traction under the most favorable conditions.

Mr. Knowlton urged that the compact assembly of power under the electric vehicle affords an increase in acceleration, and the latter is the key of modern rapid transit. This is the great point from which to work in introducing commercial vehicle service. Schedule speed, which includes stops, is far more important than maximum speed. The horse is out of the race when it comes to handling a given volume of traffic in a given time, compared with the cheapness, economy, convenience and cleanliness of electricity. In competition with gasoline trucks and delivery wagons the electric vehicle advocate often finds himself confronted with the question of maximum speed. The future owner tends to lay too much stress upon this, for in city and suburban service the maintenance of a high average speed, including stops, is the nub of the whole question. In narrow, crowded streets it is almost always impossible to utilize the full maximum speed of a vehicle. Quick starting and rapid turning are far more important. The requirements of city and suburban service may be met by a schedule speed, including stops, of between 5 and 10 miles per hour, and the ability of the machine to run from 12 to 20 miles per hour cuts little figure. The electric vehicle suffers in no wise from lack of maximum speed capacity in urban service, compared with the gasoline car, and in the outer suburban field, where faster running is admissible, it is simply a question of whether the volume of traffic to be handled is worth the added toll in repairs which fast running exacts. A lower maximum speed means reduced tire wear and decreased depreciation of machinery. The multiplicity of parts in the gasoline car fit poorly into a scheme of high-speed operation. The acceleration powers of the electric motor compared with the reciprocating engine enable the former to meet the closest urban competition, both in the commercial and pleasure fields.

The fundamental reason for the interest of the central station in the electric vehicle is the same as that which justifies the solicitation for motor service. Primarily it is the reward of increased sales of energy, already amounting to from $1,000 to about $50,000 per year in individual cases. Secondarily, the sale of electricity for vehicle charging is distinctly long-hour business, and largely off the peak. It can therefore be handled with an absolutely insignificant expenditure for apparatus in proportion to the revenue to be derived. The advantages of off-peak business were then discussed in detail, and the steadiness and continuity of charging service cited. The volume of business which a single electric truck furnishes for the central station in a year is well worth securing, and at a rate which attracts the service. A 1-ton truck equipped with 44 Exide cells operating at 80 volts will require about 14 kw-hours per charge, and a 7.5-ton truck, say, 40 kw-hours. This means a revenue per vehicle at a 5-cent rate of from $210 to $600 per year of 300 daily chargings. Even a small company should not be long in reaching a revenue of from $5,000 to $10,000 per year with proper cultivation of the business.

An extended discussion of the influence of the volume of production, and especially off-peak business upon the cost of energy production at the station, was then given. In one case a company manufactured 4,601,000 kw-hours in a year at a cost of 1.12 cents per unit, excluding fixed charges. In a later year the output was 6,484,000 kw-hours, and the cost 1.02 cents, in spite of a rise in the cost of coal per ton. In another instance the output increased from 1,916,000 kw-hours to 2,835,000 units, and the cost fell from 1.4 to 1.07 cents. Other instances were cited along similar lines, with a brief analysis of the proportion of motor load in each year, cost of fuel and labor. The influence of such business as vehicle charging upon the load curve was summarized.

In concluding the author emphasized the excellent work now being done in the electric vehicle field in many of the larger cities of the country, with special reference to Washington, Chicago and Boston conditions. The Commonwealth Edison Company, of Chicago, is selling probably nearly $40,000 worth of electricity per year for this service. Its recent published comparison of the cost of electric and horse-drawn service in its own system has been a notable aid to the popularization of electric propulsion. Recent results in New England were reviewed briefly, with comment upon the Boston Edison Company's progressive utilization of the electric vehicle in its own service. The establishment of an all-electric garage by the Boston Electric Garage Company has been a notable aid to progress. There are now over 200 electric vehicle-charging points listed for New England in a folder recently prepared by Mr. F. J. Stone, of Boston. The advent of the electric taxicab in Boston was briefly mentioned, and the paper closed with a strenuous plea for a sound engineering investigation of each situation. Small companies can co-operate in the retaining of a vehicle expert, if they cannot afford to employ such a man permanently. Piece-meal applications will not tell the merchant what electricity will do for him, but when a reliable company offers to displace the horse and, if necessary, revise schedules of delivery wagons and methods of handling merchandise, and guarantees the financial economy of the proposition, no excuse remains for refraining from adopting electric vehicle service.

Col. E. W. M. Bailey was the next speaker, his subject being "The Electric Pleasure Vehicle—Our Mutual Interests." Col. Bailey gave a frank talk upon the benefits of co-operation. The commercial vehicle obviously has the largest field of service open to it. The magnitude of the traffic in merchandise now hauled in our cities at the railway and steamships quarters is enormous. Mr. W. P. Kennedy has shown that the electric truck can move freight at 2 cents per 1000-lb.-mile, which insures a large development of this class of business in the near future. The importance of the pleasure vehicle is often underestimated. There were 900,000 horse-drawn pleasure vehicles manufactured in the United States in 1880; 100,000 in 1890, and 120,000 in 1900, so that the possibilities in the way of pleasure service are clearly very large. Col. Bailey laid great stress upon the importance of educating the public in regard to the uses of the electric vehicle. It is an unfortunate situation that in many cases the people at large do not realize what the electric pleasure vehicle is really for, or how it fits a field that is absolutely unique. More publicity in this direction will bear good results.

Citing the large development in other parts of the country, Col. Bailey said that there is no reason why the electric vehicle should not be as popular in eastern Massachusetts as elsewhere. It helps to fill up the valley in the central-station load curve, and is, therefore, a source of benefit to the central station aside from its direct revenue. All electricity supply companies should provide proper charging facilities, as this can be done at small expense. The situation will be much helped if the operating companies will themselves purchase and operate electric vehicles for use in maintenance, inspection and official business.

An important point is to avoid technicalities in selling electric vehicles, as these only tend to confuse the purchaser and reduce his confidence in different competing makes of machines. The actual cost of energy is not in reality a very serious matter to the man who can afford a car. A man who buys a horse and

buggy does not figure on what it will cost per mile for shoeing, etc., and there is no reason why he should be stimulated to exhaustive inquiries of detail cost. The point to emphasize is the genuine pleasure which will be derived from the use of an electric car rather than the subdivided cost of tire wear and battery service per mile. Col. Bailey said that there ought to be at least 8000 pleasure vehicles of the electric type operating in Massachusetts at the present time, and the sphere of the vehicle's usefulness should be pressed home more to the public.

Mr. Day Baker pointed out that in pushing the commercial vehicle business the public is coincidently educated in the benefits of the pleasure car. The sale of one helps the other in a broad way. He cited a Western city where the central-station manager prepared a list of all the young ladies in town who were approaching the age of 16 and sent a polite letter to each of the fathers pointing out that in some communities it is the custom of fathers to present their daughters with electric carriages when they reach the age of 16 years. Several sales of cars were made in this way. Mr. Baker said that four prominent central-station men in eastern Massachusets, who have previously shown little interest in the electric vehicle, have just decided to install charging facilities and make a definite bid for this business.

Mr. Frank J. Stone emphasized the realization of central-station men that they must have a responsible interest in the care of machines sold in their territory. He said that plans are under consideration at Boston to assemble a large body of interested citizens, perhaps at the May meeting, and arouse public interest in the electric vehicle. By holding this at the Boston City Club, or a similar suitable place, and with the co-operation of the Boston Chamber of Commerce and Board of Health, Society for the Prevention of Cruelty to Animals, etc., much good might be done. In the last two heavy snowstorms in Boston 200 horses died. Enormous forces are behind the electric vehicle, including 37 manufacturing companies, numerous garages, 6000 central stations, and the electrical manufacturers. It will be most helpful to bring the situation closer to the public knowledge, and to this end it would be desirable to shown lantern slides of the buildings of the larger manufacturers in actual demonstration that this is no experimental campaign, but a genuine movement toward economy and the broad improvement of highway transportation of all kinds.

Transmission and Distribution of Energy to Heavy Moving Trains.

Under the title "The Problem of Railroad Electrification—The Transmission of Energy from the Power House and Its Distribution to Moving Trains," Mr. Frederick Darlington read an instructive paper before the Electric Club of Chicago on April 20. The meeting was well attended and the paper received close attention.

The main point of the speaker was that the transmission and distribution of electricity from the power house to heavy train units is the great "sticking point" in the problem of applying electricity in heavy traction, and that the use of high-voltage energy, specifically the single-phase system, reduces the cost of this transmission and distribution, and is, therefore, to be given careful attention. Mr. Darlington was careful to explain that his remarks were not to be taken as applying especially to steam railroad terminal electrifications, but rather to the whole problem of operating by electricity ordinary steam railroads. In the following paragraphs some of the ideas presented in Mr. Darlington's paper are set forth.

First the speaker explained that the requirements and conditions of railroads vary so widely in different sections of the country, and for different kinds of service, that it is not possible to present a general plan of applying electricity suitable for all; every specific case must be considered on its own merits. The cost of electric operation and the effect on earnings will determine where and how it will be used.

There are three distinct electric-railway systems—direct-current, single-phase alternating current, and three-phase alternating current. Any one of these systems can be used to move trains. All of them are in practical operation, and no doubt further applications of each system will be made in the future. The emphasis should not be placed on the relative merits of this or that electric system or piece of apparatus, but on the advisability of making the necessary investment to install whichever of the recognized successful electric-railroad systems is advisable.

There are three essential parts of an electric-railway installation—the generating plant, the apparatus for transmission and distribution to moving trains, and electric locomotives and car equipments. It is in the second division that there is the greatest difference between the three systems mentioned, particularly in the case of moving heavy trains over long distances. Any one of the three systems could find rapid and extensive application if it were not for the heavy cost and inconvenience of the apparatus for transmitting and distributing electric energy from the source of electricity to the moving trains. If, for example, electrical energy could be delivered directly from the power house to the train motors, say by some wireless system, steam locomotives would soon be a thing of the past; but, unfortunately, for ordinary steam-railroad train-weights and conditions of traffic, the transmission and distribution apparatus constitutes the most costly and troublesome part of the electrification project, and it is mainly because of this trouble that electricity is not in general use for nearly all heavy railroad trains.

Mr. Darlington quoted a recent paper presented in Philadelphia by Mr. C. E. Eveleth, showing that the cost of transmitting and distributing apparatus for the 1200-volt direct-current system, handling three 46.5-ton cars per train, distributed at fairly equal intervals, including substations and third-rail contact, is $13,460 a mile. With trains of 300 tons or more each, and with uneven train distribution, it is to be supposed that this cost would be exceeded. To a certain extent, more economical apparatus has been attained by the development of alternating-current systems.

The simplest electric railway transmitting and distributing apparatus met with is that used with the single-phase system. For single-track roads, where the power per train is from 1000 to 1500 hp, and where the power concentrated within very short distances along the track may be 3000 or 4000 hp, the entire cost of single-phase transmitting and distributing apparatus, including transformer stations, will generally be between $4,000 and $9,000 a mile, excepting on branches and spurs where the high-tension trolley extends beyond the limits of the high-tension transmission line. In these places, where there is no high-tension transmission line, the cost of necessary trolley and track bonding will be only about $2,500 a mile. There is practically no operating labor required for the transformer stations.

Care must be taken, of course, to make the overhead construction of this high-voltage apparatus very strong and secure. The single-phase distribution system with the single-phase catenary trolley is suitable for all places and requirements where steam-railroad trains can be operated, where the erection of overhead trolley conductors is not prohibited, and where life or property will not be jeoparded by high-tension wires securely erected 22 ft. above railroad tracks. There are no train movements made by steam locomotives that may not be made on the same tracks with electric locomotives.

In many estimates for railroad electrification the proposed cost exceeds largely the cost of the electrical equipment necessary to move the existing traffic. This is often occasioned by including improvements and track changes not essential to electrical operation; the cost of such changes should not be charged against electrical operation. It is clear that the best of the electrical systems will be limited in their use by the cost of transmitting and distributing electrical energy. Even $5,000 a mile is a heavy charge to put on a railroad, and this is a fairly low cost for single-phase apparatus for operating heavy steam railroad trains. Other systems, requiring a still

greater cost for transmitting and distributing apparatus, are necessarily under a greater handicap.

Taking up reliability of service, the speaker said that all of the three electrical systems are reliable when properly installed and operated. The reliability of the direct-current system is well known, and the reliability of the single-phase apparatus has been proved by the successful operation of over 45 single-phase electric-railway systems in America and Europe. On the single-phase system of the New York, New Haven & Hartford Railroad between the Grand Central Station in New York and Stamford, Conn., during the ten months ended April 1, 1910, the locomotive mileage averaged per locomotive delay from both mechanical and electrical causes was 12,275 miles. This is two or three times better than steam-locomotive practice in the same kind of work. For the month of March, on the same system, with over 40 electric locomotives in operation, there were only 14 motive power delays, including the delays due to the power plant, the transmission and trolley lines and the locomotives, while some of these 14 delays were due to causes that were not electrical, such as derailment and failure of air-brakes.

As for the three-phase system, it is not likely to be charged that three-phase motors are not reliable, provided the two separately-insulated trolley wires necessary for three-phase service do not prove too troublesome.

In concluding, Mr. Darlington summarized his remarks by saying that the three systems are equally reliable, but that the single-phase system reduces the cost of transmitting and distributing the electrical energy to move trains at increased efficiency.

The discussion was brief. Mr. James H. Delaney asked how the ton-mile costs of the three electric-railway systems compare. To this Mr. Darlington said it is impossible to give a definite answer, owing to differences in fixed charges, due to the cost of electrical construction. When the electrical apparatus is erected along a railroad 100 miles long, it is obviously unfair to compare it with a railroad, say, 1000 miles long, equipped for electrical operation. Mr. Williams inquired about single-phase railroad motors. The speaker answered that, so far as operating characteristics go, they are practically the same as those of the direct-current motors. Mr. Delaney persisted and asked specifically about the comparative cost of steam and electric operation on the New Haven Railroad. Mr. Darlington answered that electrical operation had resulted in many savings, but how far these savings offset the fixed charges he was not prepared to answer offhand. A cordial vote of thanks was extended to the speaker.

Meeting of Arkansas Public Utility Operators at Pine Bluff.

The third annual convention of the Arkansas Association of Public Utility Operators opened at Pine Bluff, April 27, with about 50 members present, the majority of the properties represented being the central stations of the State. The membership includes, however, gas, water and street-railway companies as well.

Following the preliminary convention business of Wednesday afternoon, the president of the association, Mr. B. C. Fowles delivered his address, in which he called attention to the need for more capital for investment in developing the valuable resources of the State, which, he thinks, is destined to become one of the most important in the Union. In reviewing the events of the past year, Mr. Fowles mentioned an adverse decision of the State courts which requires central-station and other public-service corporations to continue furnishing service to customers who are delinquent in payment. This decision leaves the companies with no protection against chronic "dead beats," and its outcome will probably be the requirement of cash deposits from the consumers sufficient to cover possible shortages. A favorable court decree within the last year sustains the right of the electric companies to charge a minimum amount monthly for each meter connected. The general rise in prices has been accompanied by the increased cost of the materials which make up the central station's outlay, yet the rates charged for electrical service remain practically fixed.

Careful investigation by the public of the actual conditions under which the average utility is operated, claimed the speaker, would result in a less critical and more tolerant attitude toward the public-service companies. The large place which the behavior of these companies occupy in the thoughts of the people is reflected in the recent reform platform elected in Milwaukee, where nine out of the 21 planks enunciated by the successful party relate to the regulation of public-service corporations. The benefits resulting from commission rule of these companies are often unequal to the expense involved upon the taxpayers, while the commissions themselves are too frequently given unlimited power and bear too close an association with politics.

Mr. Fowles spoke of the unusual qualities of skill, tact and diplomacy required in the semi-public position of managers of an electric, gas or street-railway company, besides the technical capability which the successful operator must possess. Proper exercise of tact and judgment in maintaining the confidence of the public, the speaker said, would go far to reducing the necessity for commission regulation. The use of open, glass-covered meters in explaining the measurement of energy to the purchaser is one step in securing this confidence. In closing, President Fowles thanked the members of the association for their past co-operation in the affairs of the organization, and expressed the wish that the present convention might be the most successful yet held by the Arkansas operators.

Thursday morning's session opened with a paper on "The Effect of Natural Gas Upon Municipalities," by Mr. W. L. Wood. After discussing briefly the technics of natural-gas transmission and distribution, Mr. Wood referred especially to its effect as a competitor with other forms of light, heat and power.

The advent of natural gas, said Mr. Wood, usually sees a rush to use it by many lighting and heating customers. However, after the first period of careful attention and maintenance of the lamps has elapsed, and mantles begin to break and globes become dirty, much dissatisfaction usually results. The gas companies do not especially favor lighting loads, because the income from this source is comparatively so small when the large heating and cooking consumptions are considered, that the illuminating field is not very profitable for the natural-gas company.

Natural gas as a fuel in the boiler-room results in a saving of exactly 50 per cent of the former cost of coal, in the case of the Texarkana company, where gas is now purchased at 10 cents per 1000 cu. ft. In heat value this is about equivalent, he said, to coal at $1.50 per ton. At the same time a saving of $220 a month has been made for labor, one man now doing the work of several firemen and coal passers, in regulating four boilers, although he could as easily attend eight or ten boilers. Gas burning is especially satisfactory in forcing boilers and in regulating the steam pressure closely during normal operation.

Although the Texarkana company expected to observe a decrease in its electric business with the introduction of gas, it finds that the revenue has been slightly increased from this source, while the lowered cost of fuel has further improved the more significant figures of net profit. Mr. Wood admits, however, that electrical energy at 4 cents per kw-hour for motors is not a competitor with natural gas at 10 cents per 1000 cu. ft., although very few gas engines have been installed in his field.

Mr. D. A. Hegarty discussed the question of lowering the rates for electricity supply to compete with natural gas. This was not done in the Pittsburgh field, he said, but in the case of the Indiana companies, which reduced their rates to compete with gas, the latter supply gave out after a few years, leaving the companies in the embarrassing position of being unable to restore the rates to their former value. As the result, much

of this business is now carried at little or no profit. As the history of natural-gas fields shows from seven to eight years to be the average life of such supplies, Mr. Hegarty advised electric companies to maintain their rates undiminished and to await the end of this period, doing their best to carry the profitable business meanwhile.

In answer to a comment by Mr. Felix Borden that combination gas and electric companies tend to urge electricity for lighting at the expense of gas, Mr. Hegarty denied that such companies discourage the use of gas, and also took issue with a statement that gas furnishes the best and most satisfactory light. He also showed that the short life of the average gas field makes a large investment in adequate low-pressure mains to secure good regulation inexpedient for the slight returns obtained from lighting service.

Mr. Hegarty next laid before the convention a paper outlining "A Law for the Prevention of Theft of Electricity, Gas and Water from Public-Service Corporations." The only present law bearing on this subject in Arkansas is one prosecuting wire-tapping, which is not effective in cases of theft of energy or tampering with meters. Theft is most prevalent in the case of electric supply on account of the ease of unauthorized connections. Loops around meters, taps ahead of the meters, tightened jewels and magnetic braking of meter elements are some of the common offenses to protect against which it is now the local practice, so far as possible, to set meters directly at the service entries, to make careful inspections at intervals of from 60 to 90 days, and to scrutinize all bills carefully for unusual variations in consumption.

Mr. Hegarty read, and suggested for local enactment with some amendments, the present law in force in the State of New York, which imposes one year's imprisonment or $500 fine, or both. To the terms of this ordinance, Mr. Hegarty proposed additions covering the wasting of electricity and tampering with the indications of meters. Under the proposed law anyone aiding, abetting or counseling the theft of energy is made equally guilty with the principal, while proof that the act was done on the customer's premises or that he received benefit therefrom is taken as *prima facie* evidence of guilt.

Theft of electricity is not uncommon in Arkansas, and to guard against this tendency Mr. W. L. Wood proposed to use metal-enclosed block terminals in all downtown installations. Mr. Hegarty told of the use of pole-mounted meters in suspected cases, and Mr. J. E. Cowles advocated the use of conduit enclosing all service wires up to the meter, which should be set in some standard place. Where a three-wire meter is connected behind the fuses, the neutral fuse plug can be removed, thereby deadening the potential wire of the meter, while the 220-volt energy supply is still available. It is planned to draw up an energy-theft bill which the Arkansas Legislature will be urged to enact into a law when it meets next January.

At the afternoon session, Mr. Louis Friedman read a paper on "Modern Apparatus for Street Illumination," in which he discussed series-tungsten and luminous-arc street lighting. Comparative figures showing the costs of various systems of arc lighting were submitted, together with the results of tests showing the relative illumination afforded by the various systems. Methods of figuring comparative costs of arc-lamp systems were discussed at some length by Mr. Hegarty, Mr. Cowles and Mr. Friedman.

Mr. J. D. A. Cross next read a paper on "The Extension of the Electric Heating and Cooking Device Business." The rapid introduction of the electric iron, said Mr. Cross, has no parallel among other household devices of any kind in history. The electric toaster will become an even more satisfactory and important device when its possibilities are better understood. It does its work in full view of the operator and the head of the house, and can be counted on for a consumption of 6 kw-hours per toaster each month. The electric company should sell to the customer at an advance of about 25 per cent above the cost, thus allowing a margin for advertising and for protection to the local dealers. It is found that 80 per cent of all irons, 60 per cent of toasters and 50 per cent of all other devices placed on trial are accepted by consumers, thus proving the satisfactory results of this method. The large manufacturers are now prepared to take up the construction of any special heating appliances and invite propositions of this kind. Mr. Cross said that the new electric automobile warmer for keeping the circulating systems of water-cooled machines from freezing during cold weather was first suggested by an inquiry received from Little Rock asking if the luminous-type radiator, tipped up, could be satisfactorily used for this purpose.

Mr. Felix Borden presented a paper on "Illumination from a Contractor's Standpoint," which discussed the general and special lighting of buildings. Mr. Borden described the effects of various reflecting globes, and the walls and ceiling reflections from room interiors. Polar curves were given showing the customary candle-power distribution of incandescent and arc lamps for various classes and intensities of illumination. Mr. Borden advised against the use of too high intensities in illumination, the effect of glare, he said, often being to cut down the apparent effective lighting.

In lieu of a paper by Mr. L. E. Sawyer, of Hot Springs, on "Opinions of Various Cases in Various States," Secretary Cowles read a paper on "Public-Service Corporations." The former attitude of the public to the effect that the public-service company exists only for personal gain, is now passing away, wrote the author of the paper. An interpretation of the recent court decision handed down in Arkansas which requires public-service companies to continue furnishing service after the customer has become in arrears in payment, included in the paper, was to the effect that this ruling does not apply after efforts have been made to collect the account by suit or otherwise. This paper also discussed the doctrines of the "fellow-servant" law and "assumed risk" as applied to public-service corporation affairs, and urged the appointment of a legislative committee to exercise its efforts for the passage of the best corporation laws.

Mr. W. J. Thorp read a paper on "Customers' Accounts," which was a clear explanation of the methods of billing and bookkeeping in use by the Little Rock Railway & Electric Company, and which are based upon those of the Commonwealth Edison Company of Chicago and other Edison illuminating companies. It was discussed by Messrs. W. L. Wood, B. C. Fowles, J. E. Cowles, D. A. Hegarty and J. F. Christy.

Following the close of the regular program the present officers of the association were re-elected by acclamation, and instructed to take steps looking toward the combination of the Arkansas association with the public-utility operators of Mississippi and Tennessee. Such a tri-state organization, if effected, will, it is believed, take a strong place among the similar associations of the country. Messrs. L. G. Van Ness and V. A. Henderson, of the Merchants' Power Company, of Memphis, Tenn., who were present, gave the Arkansas operators a cordial invitation to join in making a single strong public-corporation association in the States above named. The officers and executive committee unanimously re-elected are: President, Mr. B. C. Fowles, Pine Bluff; treasurer, Mr. E. Hardin, Hot Springs; secretary, Mr. J. E. Cowles, Little Rock. Executive committee: Mr. D. A. Hegarty, Little Rock; Mr. W. J. Thorp, Little Rock, and Mr. W. C. Maguire, Arkadelphia. The legislation committee comprises Mr. D. A. Hegarty, Mr. Ed. Hardin and Mr. W. L. Wood, of Texarkana. The place and date of the next meeting will be announced later.

On Thursday evening, as the guests of the Citizens' Light & Transit Company, of Pine Bluff, the Pine Bluff Corporation and the Pine City Electric Company (a local contracting firm), the members of the association enjoyed a trolley ride out to Forest Park, where a Dutch lunch was served. Matters of entertainment were in charge of a committee consisting of Mr. B. C. Fowles, Mr. T. Y. Murphy and Mr. J. R. Bloom. During the convention the blue badges of the association were honored for transportation on the city street-car lines and for admission to the local places of amusement.

Maryland Public Service Commission News.

There have been several conferences between the Governor and the two members of the commission as to the selection of the chief attorney to the commission. Chairman James M. Ambler and Mr. Philip D. Laird deem the appointment of the counsel as one of the most important things that the commission will be called upon to do, particularly in view of the coming test of the constitutionality of the Public Utilities Bill. It is said that Mr. William L. Marbury was asked to accept the position of chief counsel, but declined, as he has among his clients a number of public-service corporations and persons interested in such corporations, and he would be compelled to give up that practice if he accepted the appointment. The salary is $4,800 a year. It is believed that William Pinkney White, Jr., will be appointed assistant counsel. The Governor and the commissioners have not yet discussed the election of a secretary, who is to receive $3,000 a year. Governor Crothers is stated to favor a commission that will not run amuck with corporate wealth. He said prior to the drafting of the public utilities act that the people of Maryland are conservative, and he believed that they desire a conservative exercise of the power reposed in a commission under the public utilities law. He is believed to be inclined to the idea that the thing to do is to wipe the slate clean and begin all over again with the corporations, making sure that offenses of the past are not committed in the future.

Vermont Public Service Commission News.

The Public Service Commission of Vermont held a hearing on April 27 upon the status of telephone and other wires in the cities of Barre and Montpelier. Mr. Jas. E. Davidson appeared on behalf of the Consolidated Lighting Company, Mr. W. N. Theriault for the Moody & Almon Company, Mr. J. H. Senter for the Orange County Telephone Company, and Mr. W. A. Lord for the Barre & Montpelier Traction Company. The New England Telephone & Telegraph Company was represented by its counsel, Mr. M. Jones. After a discussion of the terms of agreement between the various interests regarding changes in wire installations it was agreed that if the extension of the service of any company which is a part of the agreement hereafter makes necessary changes in the construction of the pole lines, the company desiring such changes or additions shall bear the entire cost of making the changes in accordance with the specifications. Mr. Senter withdrew opposition to this agreement upon the introduction of an amendment which obviated the placing of unjust expenses upon any company which might enter a street hitherto unoccupied by it. Counsel Jones, of the New England Company, pointed out that it was the intention of the parties concerned, at the time of making up the agreement, that this provision should apply only to extensions where two companies occupied the same pole line, and where one of them wished to add or extend wires.

Mr. F. P. Carleton, attorney for the city of Montpelier, referred to the question of providing for fire-alarm wires, and Chairman Redmond, of the board, informed him that the top cross-arms of the poles would be reserved for such service, mutual arrangement to be made in cases where it is desirable to put such wires lower down. The city has the right to use one duct in whatever conduit construction the telephone interests undertake. A section of the agreement provides that should new development, or the business requirement of any of the parties, render it necessary to make changes or amendments in the specifications for doing pole line work, such changes shall be by agreement of all parties, subject to the decision of the commission in case of disagreement.

Chairman Redmond then took up the question of what part of the whole work should be undertaken during the present year. On Bailey Avenue, Montpelier, the specifications call for the removal of 26 poles in a linear distance of 1200 ft. President Davidson stated that the practice had been to allow from 5 to 7 per cent for the maintenance of overhead work. He said that the Consolidated Company is ready to expend about $2,500 this year for the changes, covering something under four miles of line. Mr. Jones contended that the high-tension crossings with the New England Telephone & Telegraph Company's lines ought to be first taken into account in the interests of safety. Mr. Davidson considered that the changing of two miles of line would be a fair allowance for this year, or about one-fifth of the total to be done in Montpelier. The commission's expert figured the cost of the changes at $700 per mile. Chairman Redmond said that he did not wish to impose any hardships upon the companies, but felt that four miles of work should be done in Montpelier, and all high-tension crossings between that city and Barre abolished in the present year. This would require the safeguarding of 16 crossings and the changing of 31 poles near Three Mile Bridge. Mr. Davidson said that as the lines at Three Mile Bridge are of the high-tension type, the work would have to be done on Sundays, and the cost would be upwards of $1,000. Mr. F. C. Sargent, expert for the board, emphasized the importance of the work at this point, and contended that the cost would be lower than the companies maintained. Mr. C. D. W. Jarvis, of the New England Telephone & Telegraph Company's engineering department at Boston, was selected to supervise the work. The board took the case under advisement, and will issue an order as to the amount of work which it deems necessary to be done during the year. Annual hearings will probably be held.

Inquiries of Public Service Commission Regarding Depreciation Account.

The New York Public Service Commission, Second District, made inquiries recently of companies which have not started an account to cover depreciation. The letter says, in part:

"Each of the uniform systems of accounts for electrical corporations and gas corporations prescribed by this commission, effective Jan. 1, 1909, contains an operating expense account to cover the matter of depreciation of operating property and other amortization of such property and capital. Such an account, entitled general amortization, is defined in the division of operating expenses entitled general and miscellaneous.

"Charges to this account are by the orders of this commission covering the uniform systems of accounts required to be made by each corporation to which the order applies according to 'a rule determined by the accounting corporation'; and it was further required that 'such rule and a sworn statement of the facts and expert opinions and estimates on which it is based shall be filed with the Public Service Commission on or before Jan. 1, 1909.' The above-named corporation has not yet complied with this requirement. You are, therefore, required to file with this commission before April 15, 1910, answers to the following questions:

"1. Have you set up on your books the account above named?

"2. If you have not set up such account, why have you not done so?

"3. What rule are you observing in charges to the account general amortization?

"4. Why have you not filed a copy of such rule and other matters with this commission as required by the order referred to?

"5. When do you expect to obey the order of the commission in this particular?

"Also, on or before April 15 show in detail, giving dates, amounts and all other particulars, the several entries which the said corporation has made on its books of record in the account general amortization.

"Reply to this communication, giving specific answer to each of the foregoing questions, should be received before the date named. Your attention is respectfully called to that part of section 73 of the Public Service Commissions law reading as follows: 'Every gas corporation and electrical corporation and the officers, agents or employees thereof shall obey, observe and comply with every order made by the commission under authority of this act, so long as the same shall be and remain in force.'"

Massachusetts Legislative News.

The House has passed to be engrossed the bill providing that in the sale of electricity generated by the Metropolitan Water and Sewage Board at its plant in Clinton preference shall be given to persons or corporations proposing to use all of such electricity in the town of Clinton. The committee on metropolitan affairs has voted in favor of a resolution to provide for an investigation by the Boston Transit Commission of the cost of building a subway from the Park Street station of the Tremont Street subway to the South Station, and the resolution has been given a second reading in the House. The bill giving commissions and boards authorized by law to grant locations to street railways to grant temporary locations for the purpose of enabling companies to avoid the interruption of service has been given a second reading in the House. Under the provisions of this bill the Railroad Commission is granted the right to approve such temporary locations without a notice and hearing. An order has been introduced into the House and referred to the committee on rules providing for the appointment of a recess committee to investigate the matter of false statements and reports in reference to shares of stock, bonds and other securities, to report to the next Legislature. Four additional petitions have been received by the General Court in favor of the bills allowing the New York, New Haven & Hartford Railroad Company to develop the electric transportation facilities west of the Connecticut River by the purchase of stock control of the Berkshire Street Railway Company. The committee on banks and banking has reported leave to withdraw the petition of the Massachusetts Street Railway Association for legislation more clearly to define the cases in which savings banks may invest in the bonds of leased street-railway companies. An attempt to reconsider the O'Rourke bill requiring street-railway companies to equip their cars with lifting jacks has been defeated by a vote of 107 to 85 in the House.

New York Public Service Commission News.

The second form of contract adopted by the Public Service Commission for the construction of rapid transit lines in New York City has been made public. This contract provides for construction by city funds, and a public hearing will be held upon it May 16. There will be four separate contracts and each in turn will be subdivided into sections. The first contract will cover the subway work only of the Broadway-Lexington Avenue route in Manhattan and the Bronx. The second contract is for the Broadway-Lafayette subway in Brooklyn. The third contract will cover the elevated railroad sections of the Broadway-Lexington system in the Bronx, and the Fourth Avenue subway extension in Brooklyn. The fourth contract will be for the cross-town subway in Canal Street, Manhattan, running from the intersection of Canal and Centre Streets to a point near West Street. Most of the distance of the Lexington Avenue subway will be four-tracked on the double-deck plan. The other lines will be two track, with provisions for adding two more tracks. There has been remarkable interest shown in the form of contract, published last week, providing for construction by private capital. Several hundred copies of the form have been sold to prospective contractors and their attorneys.

The Public Service Commission has abandoned its original plan of constructing a six-track terminal in the recently constructed municipal subway at Park Row and Chambers Street. For the present, at least, only four tracks will be built. The commission has notified the Board of Estimate that it will not need the $875,000 appropriated for the extra tracks. The Brooklyn Rapid Transit Company is making arrangements to bid for the operation of this subway and also for the operation of the Fourth Avenue (Brooklyn) subway which is now being built.

Mayor Gaynor has approved the bill, recently passed by the Legislature, authorizing the Public Service Commission to contract for the construction of moving platforms under Broadway from Tenth Street to Forty-second Street and under Thirty-fourth Street from Second Avenue to Ninth Avenue.

At the hearing last week, by the commission, on the reorganization plan of the Third Avenue Railroad bondholders, E. G. Connette, transportation engineer of the commission, testified that he estimated the present physical value of the property at $30,697,061.

The Public Service Commission, Second District, has received a complaint from Peter Zeichen, publisher of the Poughkeepsie *Sunday Enquirer*, against the Poughkeepsie Light, Heat and Power Company. The complainant alleges discrimination in rates in the city of Poughkeepsie, stating that he is required to pay a greater rate than other customers served by the same company.

The South Shore Gas Company has been authorized to exercise franchises in the incorporated villages of Babylon, Amityville and Farmingdale, in the town of Babylon, Suffolk County. Franchises were given to Hiram O. Odell, and he is authorized to transfer them to the South Shore Gas Company. The commission has also authorized the South Shore Gas Company to execute a mortgage upon all its property, etc., to the amount of $150,000. The company is allowed this time to issue $100,000 of bonds at not less than 85 and $25,000 capital stock, the proceeds to be used for the plant and distributing system of the company in the territory named.

The Conant-Bryant Power Company has been authorized to exercise franchise for electric lighting service in the village of Wilson, Niagara County. The franchise is held by Stuart M. Conant and Russell W. Bryant, and the order authorizes them to transfer it to the Conant-Bryant Power Company.

The Deer River Power Company, of Watertown, N. Y., has been authorized to execute a mortgage upon all its property to secure a total issue of $200,000 par value 6-per-cent, 20-year gold bonds. The company is authorized to issue at present $67,000 par value of the bonds to be sold at not less than 90, the proceeds to be used for the payment of obligations incurred by the company in developing power and generating electricity on the Deer River at a point known as High Falls and at various points above High Falls. It is the purpose of the corporation to develop power and generate electricity to be furnished to the village of Copenhagen and persons and corporations in the county of Lewis and to furnish and sell power and electricity in the county of Lewis and other adjacent counties and to such individuals and corporations as it shall be able to make contracts with.

The Thousand Islands Electric Light & Power Company, doing business at Clayton, has been authorized to issue $20,000 mortgage bonds at not less than 95, the proceeds to be used for the payment of obligations and improvements and extensions to its plant.

Public Service Commission Law in South Carolina.

An act creating a Public Service Commission has been passed by the 1910 General Assembly of South Carolina. The measure is entitled, in part: "An act to establish a Public Service Commission to fix and establish in all cities of this State rates and charges for the supply of water, gas or electricity furnished by any person, firm or corporation and the inhabitants thereof, and to prescribe penalties." The commission shall be composed of three members, each of whom shall be paid $10 a day and necessary expenses while actually employed. Failure to accept the rates prescribed by the commission and the imposition of higher rates shall constitute a misdemeanor, the penalty for which, on conviction, shall be a fine of not less than $25 or not more than $100. Each overcharge shall constitute a separate offence and one-half of the fine recovered in any court of competent jurisdiction shall go to the consumer overcharged and the balance to the city. Provision is made for a court review if the rates fixed are considered unjust and unreasonable. The cities of Charleston, Marion, Spartanburg, Sumter and Union and the town of Conway are excepted from the provisions of the act. Prof. W. M. Riggs, of Clemson College, has been appointed one of the commissioners.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued an order approving the purchase of the electrical business and property of the Lexington Gas & Electric Company by the Edison Electric Illuminating Company, of Boston. The board points out that on Jan. 1, 1910, the Lexington company's gas plant has a book value of $16,267 and its electric plant $96,538, with outstanding capital stock of $40,000, bonds of $40,000 and notes payable of $24,500. By the terms of the agreement the Edison company is to pay $87,000 in cash for the electrical business and property of the Lexington company, and provision is made that the aggregate amount of the capital stock and debt of the two companies will not be increased. The Edison company supplies electricity to the city of Boston and 31 other municipalities, including Waltham and Arlington, adjacent to Lexington, and since 1905 the Lexington company has furnished service to the adjoining town of Bedford. Soon after the purchase of the Lexington company's stock on behalf of the Edison company the lines of the two systems were connected, and the Edison company is now supplying the electricity furnished the Lexington company's customers. At about the same time, by agreement with the town officials, the Edison prices were adopted by the Lexington company, resulting in a considerable reduction, both to the town and to private customers. The board says in regard to the benefits of the consolidation: "There can be little doubt of the substantial advantage to consumers of electricity in Lexington and Bedford if this transaction is consummated. There was evidence at the hearing that this advantage is appreciated and desired by the communities in question. On the other hand, the board is satisfied that there is no disadvantage to the territory now supplied by the Edison company if this purchase and sale is approved, and that the facilities for furnishing electric energy will not be diminished thereby." The board suggests that an alliance of the gas business of the company with some other and stronger concern will likewise be beneficial to the company and the public. The commission authorizes the Edison company to issue not more than 500 shares of new stock at the par value of $100 each to raise $120,000 needed by the company in carrying through the transaction. A feature of the consolidation not mentioned in the decision of the board is the probability of the Edison company supplying energy for a considerable period to the lines of the Middlesex & Boston Street Railway Company in Lexington and its vicinity, in accordance with the service now furnished the lines of the same company in the Waltham, Newton, Framingham and Wellesley districts.

The Gas and Electric Light Commission has authorized the Boston Consolidated Gas Company to apply $568,833, the proceeds received from the sale of certain real estate in Boston, South Boston, Dorchester and Brighton, toward the payment of indebtedness incurred in additions and improvements to the plant since 1905.

The Railroad Commission recently gave a hearing on the petition of residents of the Jamaica Plain district for the establishment of a station at Green Street, on the Forest Hills extension of the Boston Elevated Railway. The company believes that no stations ought to be established on rapid transit lines except at focal points where intersecting lines occur. It is estimated that not over 5000 persons would use the Green Street station daily, while 25,000 persons using the elevated line between Forest Hills and Egleston Square would be delayed one minute each per day if the desired station should be built. In conclusion Mr. Snow submitted an estimate of the yearly cost of maintaining a station at the point in question. The fixed charges on the necessary investment, allowing 6 per cent for interest and taxes, 3.3 per cent station depreciation, 5 per cent car depreciation, 4.8 per cent power station depreciation, and 2.5 per cent depreciation on yard, structure and distributing system would be $24,699 on the investment of $242,400; and the cost of manning the station, extra train wages, lighting and station repairs would be $20,332 per year, making the total cost of the station $45,031 per annum, about half being the expense of stopping trains. The board took the case under advisement.

The Railroad Commission has been requested to give a hearing upon the petitions of the South End and Roxbury Improvement Societies for the restoration of service on the Boston Elevated Railway from Grove Hall to Park Street subway station via Blue Hill Avenue. The Selectmen of Watertown have petitioned the board to investigate the service of the Boston Elevated Railway Company between that community and Boston. The company recently transferred the majority of its through Watertown cars from Park Street subway to the Hanover Street district of Boston as a terminus, in order to decrease the volume of traffic which at present obstructs the movement of cars on Boylston Street. It is probable that the company will point out that the present Watertown service is on a temporary basis, in view of the approaching completion of the Cambridge subway, which will provide better transportation than is at present possible by surface lines.

Low-Pressure Turbine Generator as Ship Propulsion Auxiliaries.

A system of ship propulsion which combines high-pressure steam engines, low-pressure steam turbines and electrical generators and motors for driving the propeller shafts is the subject of a patent recently granted to Mr. W. L. R. Emmett.

A contemplated arrangement of the main elements is shown in Fig. 1, which represents the stern of a vessel equipped with

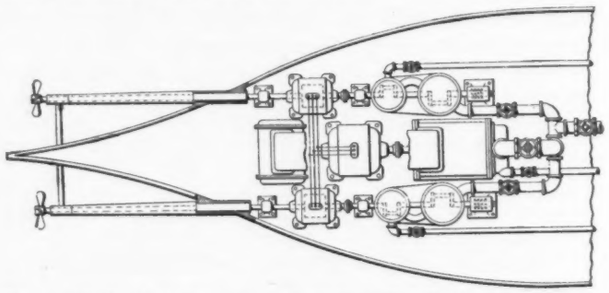


Fig. 1—Mechanical Arrangement of Propeller-Driving Machinery.

this apparatus. Crank-connected to each of the screw-propeller shafts will be noted a reciprocating engine which is of the low-speed, high-pressure compound type. The engines exhaust into the low-pressure turbine shown between the reciprocating machines, this turbine being directly connected to a three-phase alternator, which supplies energy to the motors mounted on the propeller shafts. The turbine-generator unit is operated at an economical speed, much in excess of that of the slow-speed propellers which are most efficient at speeds much below those of the steam turbine. In the construction of turbine-driven

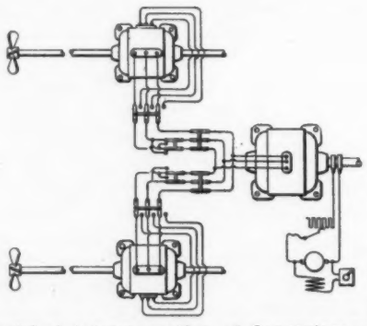


Fig. 2—Electrical Interconnection of Generators and Motors.

vessels to date the effort at compromising the inherent high speed of the turbine and the necessarily low speed of the screw propeller has not proven thoroughly satisfactory.

Fig. 2 shows the electrical connections of the generator and motor, including the arrangement of switches for reversing and varying the number of poles to secure speed control. The alternator is shown excited by a small direct-current generator.

CURRENT NEWS AND NOTES.

Repair to Paris Subway.—Some idea of the extent of the damage done to the Paris subways during the January floods can be gained from the fact that the controlling company has just issued a loan of $5,000,000 to enable it to complete the repairs.

To Organize Wireless Amateurs.—In connection with the measures before Congress looking to Government control of wireless telegraphy, an effort is being made to organize the amateurs and experimenters into a national body. Information with regard to the new organization may be obtained from Mr. George Hiram Mann, New Hibbs Building, Washington.

Price of Tungsten Ore.—Recent shipments of tungsten ore from the Boulder, Col., district have been at the rate of $30,000 per week. The present price is $7.50 per unit for a 60 per cent product, which is equivalent to 37½ cents per pound of tungsten metal content. One pound of tungsten will make more than 20,000 incandescent lamp filaments. The large quantities of tungsten ore mined are used in the iron industry.

Charlotte Meeting of Cotton Manufacturers.—Among the points of interest to be visited by the members of the American Cotton Manufacturers' Association in connection with its fourth annual convention at Charlotte, N. C., on May 17 and 18, are the generating stations of the Southern Power Company and the electrically driven textile mills recently examined by the members of the American Institute of Electrical Engineers.

Control of Telegraph and Telephone Service.—By an amendment incorporated in the Administration railway bill, the United States House of Representatives has declared that telegraph and telephone companies are common carriers and hence are subject to control by the Federal Government. The amendment was made to the portion of the bill defining the term "common carrier." The committee defined it so as to include express companies and sleeping car companies. The amendment adds, "and also telegraph and telephone companies."

Baltimore Street Lighting Bids.—The Consolidated Gas, Electric Light & Power Company, of Baltimore, has offered the following bids for street lighting: Arc lamps from overhead service, 1770 in number, for one-year contract, $60.25; for ten-year contract, $55.90. Arc lamps from underground service, 956 in number, $75 on one-year contract and $69.60 on ten-year contract. Incandescent lamps, overhead distribution, $23.50 for 40 cp and $29 for 80 cp; underground distribution, $48.50 and $54, respectively. For electrical energy, 20,000 kw-hours per annum, 6 cents per kw-hour; for next 20,000 kw-hours, 5 cents, and over 40,000 kw-hours, 4 cents. For 15,000 kw-hours supplied from any one service, 3 cents per kw-hour.

Meetings of the A. I. E. E.—The annual meeting of the American Institute of Electrical Engineers will be held in New York on May 17, at which time the result of the membership vote for the officers will be announced. Mr. John W. Howell will present a paper dealing with the characteristics of incandescent lamps. At a special meeting of the Institute to be held in New York on May 27, a paper entitled "The Application of Porcelain to Strain Insulators" will be read by Mr. W. H. Kempton, and one on "Electric Railway Overhead Construction" will be read by Mr. W. N. Smith. The annual convention will be held at Jefferson, N. H., on June 27, 28, 29 and 30.

Milwaukee Municipal Lighting Plant Enjoined.—The Wisconsin Supreme Court has upheld an injunction granted by the lower court against the equipment of the proposed municipal electric lighting plant of the city of Milwaukee, because the City Council in 1904 did not make sufficiently clear the purpose of a proposed bond issue of $500,000, voted on at the time on the supposition that it was to be used for the construction and maintenance of an electric lighting plant. The city has purchased a site for the plant costing $67,000. Another election will be necessary before further bonds can be issued for equipping and maintaining the plant.

Engineer's English.—Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, addressed the Lewis Institute Branch of the A. I. E. E. in Chicago on the evening of April 27. Mr. Pope's subject was "The Education of the Electrical Engineer," and he laid stress on the importance of the correct use of English by engineers. Whatever the educational superstructure, he said, we must not overlook the fundamental importance of the old three R's. The engineer must know how to express himself correctly and precisely if he expects his reports and other business papers to gain favor with his clients. On the forenoon of April 28 Mr. Pope gave another talk on the same general subject to the electrical students of Armour Institute of Technology.

Electric Decorations in Honor of the Dutch Princess.—In honor of the first birthday of the Princess Juliana, on April 30, the municipal electric department of The Hague, Holland, erected an electric light portrait of Queen Wilhelmina with the baby princess in her arms. The framework is about 19 ft. in diameter, and the portraits, which are said to be very good, are outlined by means of about 3000 small lamps. The sign is placed near the Vyverberg, and the lights are reflected in the waters of the lake, which is near the Houses of Parliament. By a flashing arrangement the lamps are lighted gradually, as if some one were drawing the portraits. The frame next appears and finally the whole is surmounted by the royal crown. After being lighted two minutes, the lights are extinguished, and the cycle of operations is again repeated.

Western Electric Pensions for Employees.—The Western Electric Company has adopted a system of pensions for employees, and has now a pension fund of $597,500. The fund is managed by a board consisting of five officers, who are employees of the company, appointed annually by the board of directors or executive committee. All employees who have reached the age of 60 and have been in the company's service 20 consecutive years are eligible to the pension privileges, whether able to work or not, and are not debarred from going into other business if they accept the pension privileges. Employees who have been 30 years in service or who have reached the age of 55 and been 25 years in service may on recommendation of the president be granted a pension allowance. Any employee who has been 10 years in service and through injury or sickness has been incapacitated from work, may receive aid from the fund at the discretion of the pension board. About 20,000 employees are on the payrolls of the company.

Fined for Defrauding Telephone Company.—A Chicago doctor and his office attendant were each fined $25 and costs in the Municipal Court of that city recently for violation of a city ordinance making telephone users liable to punishment for manipulating toll telephones to get a free call. The defendants used a nickel telephone, and it was noticed by the telephone company that the number of calls far exceeded the number of nickels in the box. The case was reported to the city prosecuting attorney, who brought suit. The defendants did not put in a personal appearance, but pleaded guilty by their attorney. The costs amounted to about $60 in each case, so that the total amount paid by each of the guilty persons was about $85. The character of the apparatus used to defraud the company is not known. It is to be remarked that the Chicago Telephone Company has about 120,000 nickel telephone subscribers, and the number of persons who try to "beat" the company is very small, indeed. The experience of the company is that almost all of its nickel customers are honest, but it feels gratified that there is a remedy at hand to use against the extremely slight proportion that are dishonest. This case is the first one tried under the ordinance providing for prosecuting such offenses, which was passed last October.

Denver City Lighting.—The current issue of *Denver Municipal Facts,* a weekly journal published by the city of Denver, Col., states that the cost for street lighting for the month of March, less outages, was $13,402.24. The total number of arc lamps is 2313. The cost of lighting the well-known "Welcome" arch was $75 for the month.

Carnegie Engineering Building at Union University.—The general engineering building, costing $100,000, which Mr. Andrew Carnegie presented to Union University, at Schenectady, N. Y., was opened on April 28 with appropriate ceremonies. The engineering school has received an endowment of $100,000 from the alumni to comply with the conditions of Mr. Carnegie's gift.

Winnipeg Electrical Show.—An electrical show will be held at Winnipeg, Manitoba, July 13 to 23, under the auspices of the Winnipeg Development and Industrial Bureau, a civic organization. This organization is also planning a permanent industrial exposition open all the year around, and with operating exhibits with free electric energy supplied by the municipality.

Pennsylvania Engineers' Annual Convention.—The second annual convention of Pennsylvania engineers will be held June 1 to 4 at Harrisburg, under the auspices of the Engineers Society of Pennsylvania. The program includes a number of lectures, of which the subjects are not yet announced, and an excursion to the McCall Ferry plant. As at the meeting of last year, an industrial exhibit will be one of the features of the occasion.

Control of Cable Rates.—Plans are being perfected by Canadian Postmaster-General Lemieux for having Canada and the United States join in initiating a movement having in view obtaining international agreement for the control of transatlantic cable rates. It is probable that provision will be made for such an agreement in the Lemeiux bill relating to the control of cable rates by the Dominion Board of Railway Commissioners.

Oklahoma Convention.—The annual meeting of the Oklahoma Public-Utilities Association will be held in Sapulpa, Okla., May 9, 10 and 11. There will be no regular papers, but instead there will be oral discussion exclusively on various subjects presented in a list previously sent to the members. This plan is an experiment, which is to be tried out at the Sapulpa convention for the first time. Mr. E. C. Reynolds, of Sapulpa, is president of the association, and Mr. Galen Crow, of Guthrie, is secretary.

South Carolina Public Service Commission.—Governor Ansel has appointed Prof. W. M. Riggs and Messrs. T. M. Raysor and J. E. McDonald members of the South Carolina Public Service Commission, which has been formed to fix and establish in all cities of the State with the exception of Charleston, Marion, Sumter, Spartanburg and Conway, rates and charges for the supply of water, gas and electricity furnished to the different cities or the inhabitants and to prescribe penalties for violation.

Meeting of the Empire State Association.—An important meeting of the Empire State Gas & Electric Association will be held at Syracuse, N. Y., on May 11. The morning session will be devoted to discussion of matters pertaining to the gas industry and the afternoon session to the electrical industry. No program has been prepared for the meeting and, as the discussions will be informal, any subjects upon which delegates desire information may be suggested. The Syracuse Lighting Company has invited the members of the association to inspect its plants.

The Next A. I. E. E. and W. S. E. Joint Meeting in Chicago.—The next joint meeting of the Chicago section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers will be held at the rooms of the latter on the evening of May 25. This will be the last of these joint meetings of the two societies of the season. The speaker will be Mr. Frederick Darlington, electrical engineer of the Westinghouse Electric & Manufacturing Company, whose subject will be "Commercial Characteristics of Different Types of Electric-Railway Equipment."

Wisconsin Interurban Railway Right-of-Way Decision.—A decision holding that an interurban railway cannot be run over land which has not been condemned according to law has been made by the Wisconsin Supreme Court in a decision upholding an injunction against the Milwaukee Electric Railway & Light Company, which operates an interurban line between Milwaukee and Waukesha, Wis. The court orders the electric railway company to cease running its cars on Wells Street in Milwaukee until it obtains the right-of-way in the manner provided for by law. The company asked to be allowed to pay compensatory damages in lieu of an injunctional order, but this the court held neither possible nor lawful. It is probable that a rehearing will be asked for, in which case the court's order will not have to be obeyed before the end of 30 days.

Papers at Southwestern Convention.—At the sixth annual convention of the Southwestern Electrical & Gas Association, to be held in Beaumont, Tex., on May 12, 13 and 14, papers bearing the following titles will be read: "The Watt-Hour Meter in Actual Operation," by Mr. O. Brasher; "Suggestions for a Standard Rule Book for Operation of City Cars," by Mr. H. S. Cooper; "Condensers for Small Central Stations," by Mr. Harry Pennington; "The Internal Combustion Engine in the Small Central Station," by Mr. R. B. Stichter. There will also be several papers relating to the gas industry. The headquarters of the association will be in the Crosby Hotel, and the meetings will be held in the Kyle Theater. An exhibit of electrical apparatus will be given in a large room in the theater building. The office of the association is at 300 Commerce Street, Dallas, Tex.

Alternating-Current Signals on Pennsylvania Railroad.—The engineering department of the western division of the Pennsylvania Railroad has begun work on the installation of an alternating-current block signal system between Dixon, Ohio, and the junction with the Grand Rapids & Indiana Railway. This is stated to be the first place on the Pennsylvania Railroad, and possibly the first on any steam railroad in the country, where the use of alternating current signaling systems has been tried. Interurban railways have used this system with success, and the steam railroads are now taking it up. Electrical energy will be supplied from a central power house in Fort Wayne, Ind. Direct-current signals are usually operated by means of batteries, and the alternating current does away with the care and maintenance of batteries, and furthermore, permits of extending the signaling system over a greater distance than is considered practicable with direct current.

Engineering at Johns Hopkins.—It is announced that a school of higher engineering will be established by Johns Hopkins University where graduates of technical schools and practicing engineers may come and take up the research work which is so needed in the technical lines. The school will bear the same relation to the existing technical schools that a university bears to a college. The announcement adds that the development of technical instruction has not kept pace with the marvelous growth of the country. "The large manufacturers of the country spend millions of dollars in developing new processes of work, but have spent little in the developing of men. The university is particularly well adapted to the inauguration of such work. There will arise a body of trained scientists and workers in research from which the manufacturing interests of the country will freely draw. The standard of scholarship will be on a par with that of the medical school, and this will be only one more field in which Hopkins will take the lead."

COMBINATION ICE AND LIGHTING PLANT.

Satisfactory Operation of the Noblesville (Ind.) Heat, Light & Power Company's Station.

By C. E. LAYTON.

THE company which is operating the plant described in this article is located at Noblesville, Ind. The city has a population a little in excess of 5000, and has about the average number of industries for a place of this size. There is a very good supply of natural gas which furnishes an active competition in both lighting and industrial work. The company started 24-hour electric service in June, 1906, and up to the present time has connected 225 hp in motors. Residence, commercial and street-lighting service is furnished, there being 500 consumers served and 82 street arcs used for public lighting. A downtown office is maintained for the convenience of the electricity and ice customers, and also for display purposes.

The electrical equipment consists of a 300-kw turbo-generator unit, a 75-kw direct-connected, tandem-compound engine unit and a 150-kw belted-engine outfit. All generators supply 60 cycle, two-phase current at 2300 volts. Both the turbine and engine operate condensing, using surface condensers, but the engine-driven units are used only when the turbine is out of commission.

The boiler plant consists of one 200-hp Atlas water-tube boiler and two 200-hp Stirling water-tube boilers. Shaking grates and a strong draft are provided in order to burn the cheap grades of Indiana and Illinois slack coal used for fuel. A private sidetrack runs along one side of the power house in front of the boilers. This track is 7½ ft. above the boiler-room floor and allows hopper cars to be used for dropping the coal immediately outside the boiler-room.

One of the best features in the operation of a combined electric light and ice plant is the fact that as the demands for light become less with the approach of summer, the sale of ice is on the increase, and consequently in place of the receipts falling off, a substantial gain is shown. Also for the reason that the lighting load is smaller in summer, the increase required in power-plant equipment is often negligible except for the ice machine. Although the ice-plant load extends over the peak during the hot weather, at this season the lighting peak is smallest and shortest. In fact, the actual increase of the maximum load in summer with the ice plant running was just 8 per cent over the maximum electric light load in winter. So in the usual electric light and power plant there would be no need of a further investment in boilers, engines or generators in order to operate an ice plant.

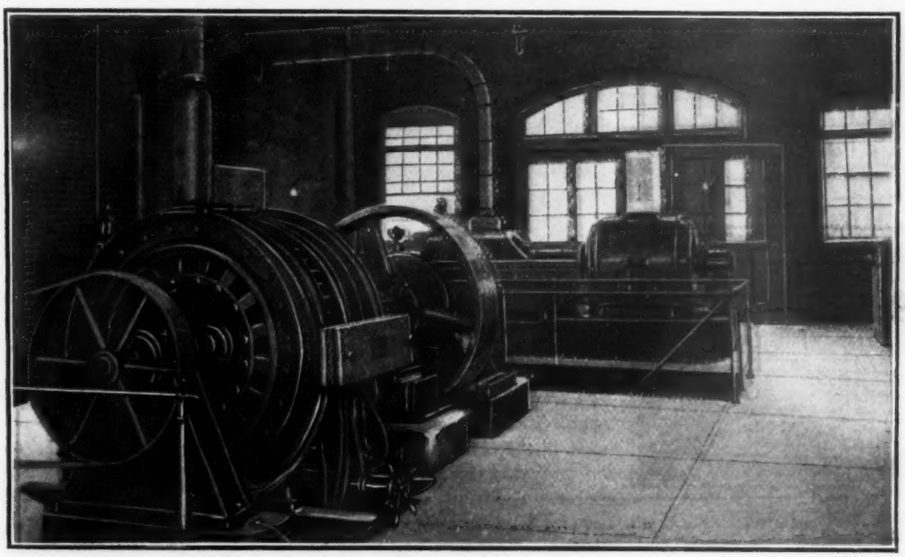


Fig. 1—Electric Generating Equipment of the Noblesville Heat, Light & Power Company.

There is also a saving in labor effected by a combination of the two plants described. The electric light plant at Noblesville requires four men for its operation, namely, two engineers and two firemen; in addition part of another man's time is required to help handle coal and ashes. With only the ice plant running two more cheap laborers are required for pulling ice, and these men give what assistance the firemen require so that the extra man noted above is not then used. An ice plant operating independently, making 12 tons of ice per day, would require at least four men for its operation, the expense of two engineers being saved by the joining of the two concerns. In the office the manager and bookkeeper do all the work winter and summer, so that a material reduction in office expense is effected by the union of the two plants. Even if a little more help here were required, this item would not be large.

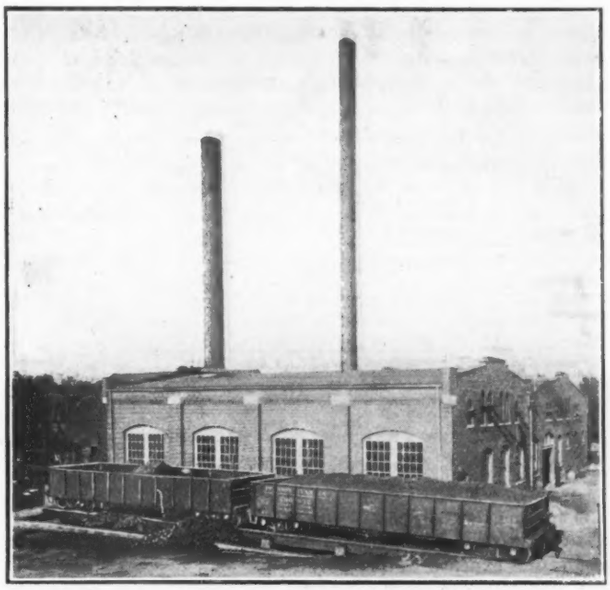


Fig. 2—Station of the Noblesville Heat, Light & Power Company.

As stated above, the ice plant has a capacity of 12 tons per day. More ice than this is disposed of during the hot days of summer, but this demand is largely met by drawing on the storage rooms which are filled with ice during the cooler part of the season. The delivery of the ice calls for one two-horse wagon and one single wagon. The single wagon is used for all deliveries during the winter and for handling special orders during the summer. This requires the use of three horses, but as only two of these are needed the larger part of the time, there is a chance to rest one horse. In the winter, fall and spring when the ice business is small, the team is used by the lighting department in construction work and for other purposes so that it pays for its keep in this manner.

The ice is manufactured by the compression system, the ammonia compressor being driven by a 40-hp, 2300-volt motor. This motor runs steady 24 hours per day from May to about Sept. 1, and considerably improves the plant load factor. Vary-

ing quantities of ice are manufactured during other months of the year, but the plant is never run at such times except on off-peak hours. The steam turbine is run with a 28-in. vacuum and the condensation supplied by the surface condenser makes excellent water for filling the ice cans. Of course, this water is passed through the usual re-boiler, cooling and filtering system before reaching the cans. When the turbine is not running and engines are carrying the load, the exhaust steam passes through a vacuum oil separator before reaching the condenser as a sufficient quantity of cylinder oil is contained in the engine exhaust to discolor the ice and impart to it a bad flavor. The oil separator is examined from time to time and cleaned. A 2-hp motor drives the brine tank agitator, which circulates the brine to furnish the same temperature at all points in the tank

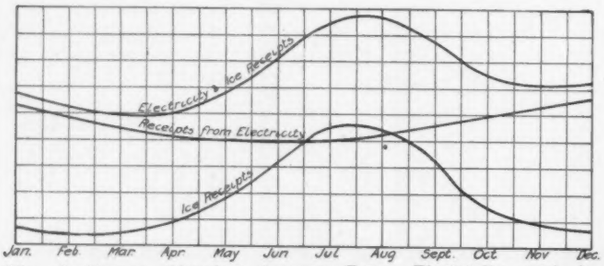


Fig. 3—Curves Showing Income From Electricity and Ice During Year.

so as to freeze the ice evenly. This is very important, as without it the product would be very much inferior.

The cost of energy for running the ice plant with electricity at 1 cent per kw-hour is 60 cents per ton. In addition to this cost is the expense of pulling the ice and delivering it. The cost of delivery in summer is 52½ cents per ton, including the keep of the horses; in winter this cost is larger, being about 67 cents per ton at that time. Ice is sold on the coupon system, the books being sold for cash. There are some cash ice sales, but the rate is 5 cents higher per 100 lb. in this case, and so the company does not have much of such business. In order to furnish some idea of the relative receipts of the lighting and ice departments the curves given herewith are of interest. It will be noticed that for two months during the summer the receipts for ice are larger than the receipts for electricity, and this, as has been already stated, is obtained with an 8 per cent increase

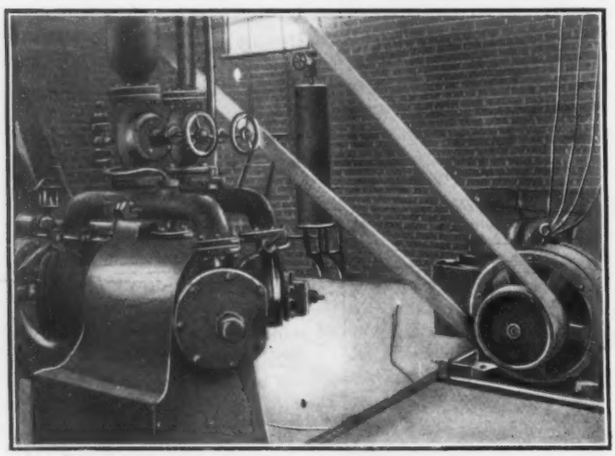


Fig. 4—Motor Driven Ammonia Compressor, Noblesville Heat, Light & Power Company.

in load on boiler and generating plants. In fact, the combined receipts during every month show a substantial gain, and the operation of the combination has proven very satisfactory to this particular company. It will, of course, be appreciated that the station output at Noblesville is not very large; the load ordinarily being carried by the 300-kw steam-turbine unit. The company, however, is typical of many others who have found it profitable to undertake the manufacture of ice.

RECONSTRUCTION OF A COUNTRY PLANT.

Work Necessitated by the Consolidation of Two Connecticut Companies and the Way in Which it was Performed.

By Parker H. Kemble.

THE way things are done is as interesting to many engineers as the result obtained. The description of the Northern Connecticut Light & Power Company's plant which appeared in these columns in the first issue of January brought to mind many incidents that occurred during the reconstruction period from September, 1906, to September,

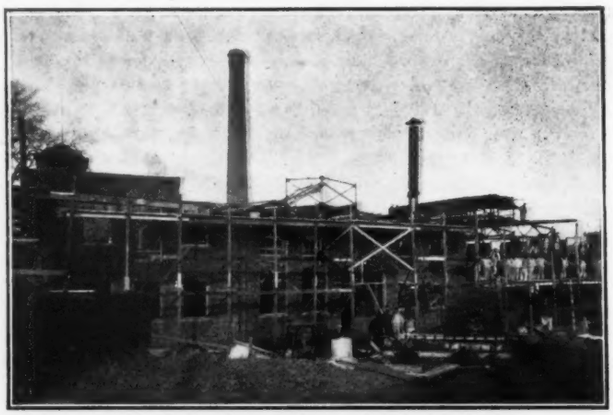


Fig. 1—Rebuilding Station at Windsor Locks.

1908, while the writer was responsible for the rebuilding and operation of the system.

THE PROBLEM.

The conditions in September, 1906, were typical of many places all over the country. There were two small plants catering to the needs of a territory some 12 miles in one direction and 13 miles in the other. One was a direct-current station with an alternating-current appendix, all steam; the other a single-phase alternating plant with a small water-wheel and steam auxiliary. The two plants were about 7 miles apart on opposite sides of the Connecticut River. The rates were different; the systems were different, and the whole way of handling the public was different. The problem was to consolidate the two companies and centralize the energy production around the small available water-power which would carry the prospective day load and the early morning load for several years.

THE SOLUTION.

As in most small plants there were no available data on which to base future growth; no accurate record of maximum load even, and none at all of connected load. From the size of the engines in the North or Thompsonville plant, aided by an indicator card a year old and of somewhat doubtful reputation, the immediate future needs of the North plant were placed at 225 kw. The South plant by a similar process was found to require about 125 kw. There was a complication here, however in the shape of a 125-hp breakdown contract which had to be provided for, also the water supply for the wheel was uncertain during the winter months, and as the breakdown service was normally supplied by the same canal as the wheel, full steam capacity had to be provided for. In the steam equipment at the North plant were one 120-hp boiler and one 250-hp engine worth moving. At the South plant there were two good 150-hp boilers and one wreck of an engine rated at 125 hp. This engine had been out of business for several weeks the previous winter and could not be relied upon. With the exception of a new 175-kw Bullock three-phase generator just received but not connected, none of the electrical equipment was suitable for the consolidation. The direct-current equipment

of the North plant, by the way, was badly overloaded and threatening to go out at any time.

A 300-hp, high-speed, single Corliss engine that was ready for shipment was ordered for immediate installation in the South plant. This engine, connected to the new 175-kw generator, would, if necessary, easily carry both the normal load and the breakdown service. Under the old rule of 1000 volts to the mile, 6600 volts for the transmission between the two plants was chosen and 2200 volts was taken for local circuits, this being about the machine voltage. Six 75-kw, single-phase, 6600-2200 volt transformers were ordered. Contracts were also placed for one 160-kw, three-phase, 2200-volt generator to be run by the North plant engine when it was moved to the main plant, and for a 180-kw, three-phase, 2200-volt generator for the water-wheel at the main plant. This capacity was based on statements of tests made previous to the writer's taking charge, and was much too large; the greatest power ever obtained under favorable conditions being 146 kw, this including the exciter. The next spring, the old engine at the main plant having taken a new lease of life under careful nursing, the single-phase Stanley inductor alternator was rewound from 125 cycles, 1100 volts, to 2200 volts, three-phase, 60-cycle, with a rating of 135 kw, at a cost of only $800, and proved a most serviceable machine.

RECORDS AND BOOK-KEEPING.

While the contracts were being placed, the book-keeping was changed over to a simple card system, in order to get the material in such shape that some useful data could be dug out of it. The start was very simple; a stock card, customers' card, and cash-book page being the beginning. As fast as omissions became evident, they were supplied, until at the end of four months or so the book-keeping was in fairly satisfactory condition. The office force consisted of a bookkeeper, and a typewriter with a shorthand capacity of about 40 words per minute. Three sets of accounts were kept until Dec. 1, when the consolidation took place, and then only two, the construction and regular company accounts, were maintained.

PUBLIC POLICY.

The South plant customers were being changed over from a flat rate to the meter basis with the usual accompaniment of complaints. There was a very general impression among the customers, absolutely ungrounded, that under the previous management the meters were regulated according to what the traffic would stand. This arose chiefly through the use of meters which had to be opened and adjusted on the premises. As a matter of policy a change was made to a meter which required no adjustment, and the slogan "direct from the manufacturer to the consumer under seal of the manufacturer" proved a very potent help in quieting the usual irritation attending the change. Both plants at this time were on night service only, and there was the usual trouble due to customers wanting light early and the company with a flat rate starting up late. As the meter-changing campaign was on, it was thought good policy to educate those not yet changed over to longer-hour burning, so energy was put on an hour earlier afternoons and kept on ½ hour later mornings. The result made no serious hole in the coal pile, and did create a pleasant feeling toward the new management. A raise in voltage from 110 volts to 115 volts improved the service sufficiently to offset the shorter life of the customers' lamps, while the policy, "Very likely the company is wrong; let us look into it together," followed by prompt reparation if the company was wrong, and equally prompt enforcement if it was right, soon put relations between the company and its customers on a less hostile basis.

THE TRANSMISSION LINE.

With the start in the transmission line, tree-trimming troubles began, and these caused as much worry as any other of the problems. The line consisted of No. 4 medium hard drawn copper placed on 18-in. centers. Bare wire was used over most of the line as being much stronger than insulated at the same cost. Brown porcelain Locke insulators were used on locust pins set into yellow pine cross-arms. The poles were from 35 ft. to 45 ft. long, according to location, with 7-in. tops. All poles were picked for looks as well as good quality, and were shaved and the butts painted with tar before setting.

The line also carried a street lighting and customers' circuit on cross-arms set 5 ft. below transmission cross-arms. Part of this line was rushed through during the winter months so that the street and commercial circuit could be extended for new business. Some trouble was caused at first by calling this line the "high-tension" line, as the Connecticut Company was putting a 20,000-volt line through nearby and one of the chronic kickers always found in communities of this size was circulating lurid descriptions of the dangers of 60,000-volt lines,

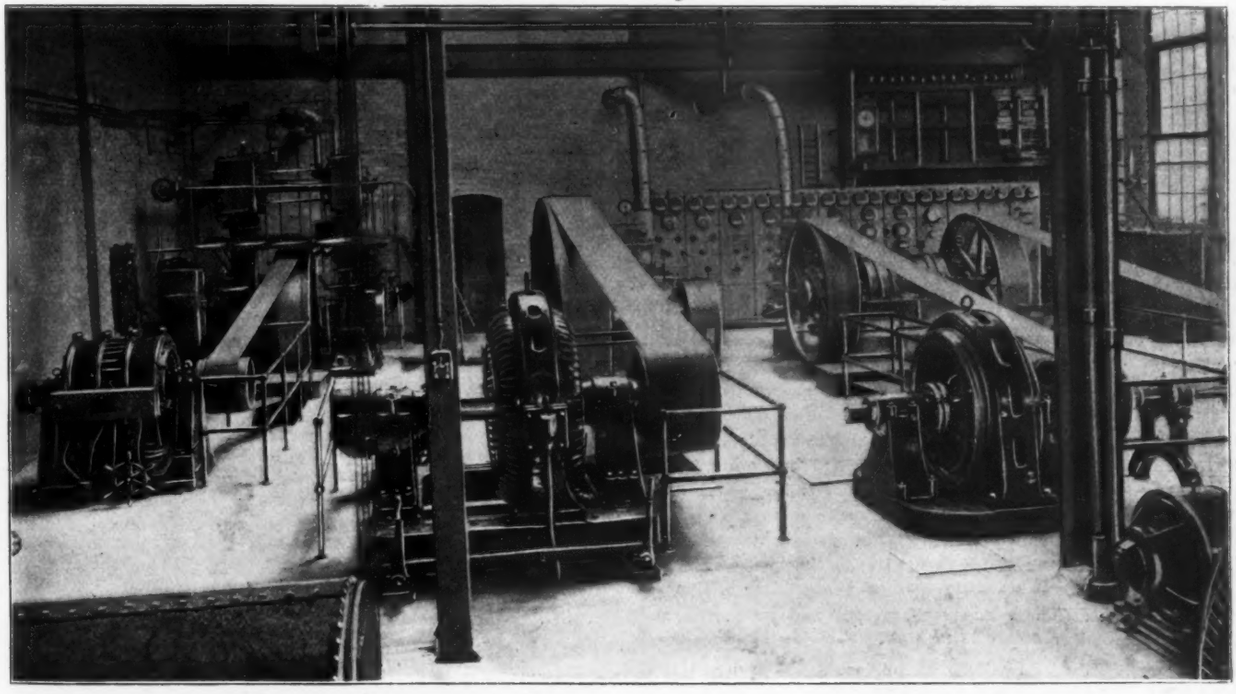


Fig. 2—General View of the Generating Equipment in Windsor Locks Station as Finally Installed.

regardless of the actual voltage proposed. Some accounts of 6600-volt trolley lines in Western cities, and a change in the name to a transmission or long-distance line, soon quieted talk. This is a good instance, however, of the necessity of picking words when dealing with the uninformed public.

THE MAIN STATION.

The rebuilding of the power station on top of the old station beginning in November without interfering with the service

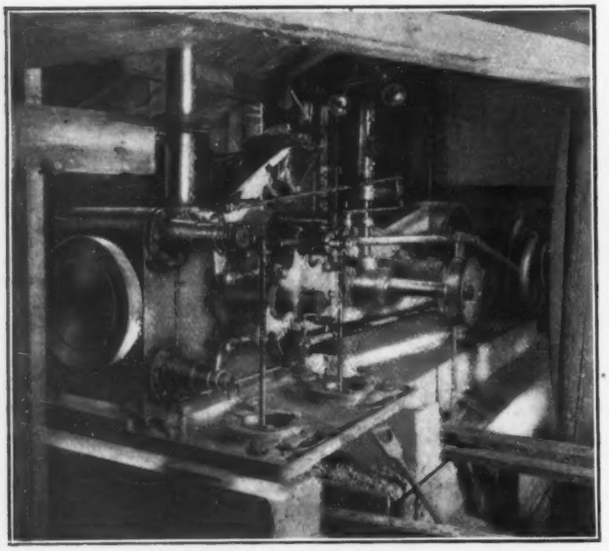


Fig. 3—Installing Corliss Engine.

was the most interesting part of an interesting problem. The whole system, while small, was a working model complete in all details—water-power, steam auxiliary, local distribution, raising and lowering transformers, transmission line, lightning trouble, motor circuits, street-lighting circuits, substations—all the elements were there except cable troubles, on a very small scale, of course, but experience shows that troubles do not increase in direct ratio to kilowatt capacity. After many tentative arrangements of machinery, the present layout was arrived at, and a day spent at the Berlin Construction Company with the entire use of two good draftsmen changed some very crude sketches into working blue prints from which the present station was built. That evening the contract for the structural steel was signed and the next day the foundations for the new building were started under the direct supervision of the writer. The foundation for the columns had to be carried down from 14 ft. to 16 ft. to bed rock through a mixture of sand, clay and water. Fortunately, the footings came clear of the machinery, although clearances were in one case measured by fractions of an inch. With the arrival of the structural steel came a series of sleet and rain storms and the roof, which was already decrepit, gave up all attempts to shed water. The leaks grew so large that it became necessary to build shed roofs covered with tar paper over the various machines and belts. Some of these are shown in the engravings. It was a worrying sight to see the attendants dressed in mackintoshes attending to 1100-volt machinery with much of the station wiring on porcelain knobs. The men were careful and interested and the company had great good fortune in escaping both accidents and shutdowns. The plans of the building called for a concrete roof, and as that could be laid only when the temperature was above freezing, as soon as the structural ironwork and walls were in place, a temporary plank and tar-paper covered roof was built across the crane girders and troubles in that line ceased for a while. Outside of those who have experienced such troubles, few can realize the incessant care of bearings required when brickwork and old buildings are being torn down directly over machinery. After much experimenting with various materials for coverings, felt sheeting from the paper mills was tried. This was expensive, but dustproof, and in conjunction with gaskets of wicking on all shafting next to the bearings was of great help; but in spite of all, every man around the station was an expert on hot bearings before the winter was over.

The new switchboard was located outside the old building, and as the board had come another shanty was built over the place it was to go and a 12-panel marble switchboard was erected complete under this temporary cover. This board was put in service when the tension was changed to 2200 volts, some time before the permanent roof was finished. The foundations of the new Corliss engine came half in and half out of the old building, so that a generous hole in the wall and another shanty attachment were required. This engine is shown in Fig. 1 connected up and ready for steam, so that in case the old vertical broke down the company should not be helpless.

One of the greatest drawbacks to the work was the intense cold. The best that could be done in the heating line was to add about 15 deg. to the outside air, which much of the time was near zero, and engineers in ulsters getting steam into an engine with the thermometer in the engine-room at 14 deg. or 15 deg. was not, as Kipling would say, "regular engineering." The boiler-room was a two-story building next to the engine-room, and when the erectors came, the roof was torn down in sections to make room for the structural iron. During the last change over, while the roof trusses and monitors were being set, the two boilers did duty for five days with no protection overhead but a layer of ⅞-in. hemlock boards. Fortunately, the weather remained clear during the time, but the temperature was below 20 deg. the whole time. Fig. 1 was taken during this period, and a careful scrutiny will show the old station through the windows of the new. An ice jam in the midst of things caused the company to break into advertising in the local press on the merits of central-station service. The advertising hit right and was of great help in starting interest in central-station service. A word on the switchboard

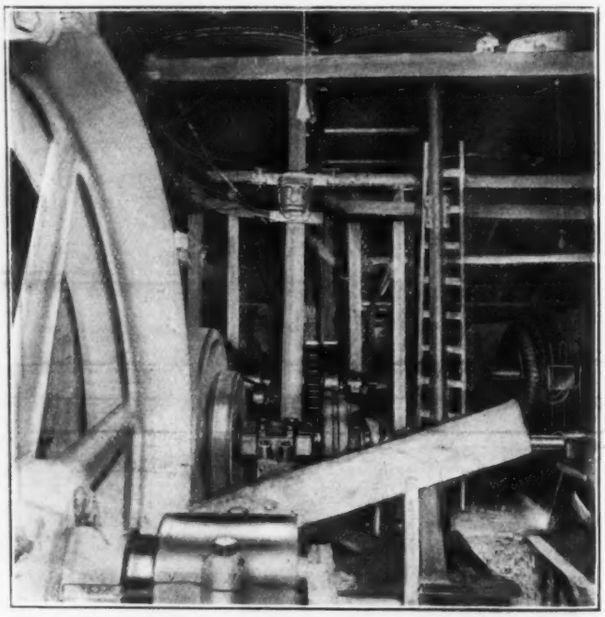


Fig. 4—View of Station During Reconstruction.

may be of interest. There were two exciter panels, each controlling two exciters all feeding into an exciter bus, and four generator panels with non-automatic oil switches. Normally the exciter on the water-wheel supplied energy for the whole excitation. Of the six panels remaining there was one panel for controlling the transmission line, one motor circuit panel which carried the three-phase motor load, both fitted with circuit-breakers; three feeder panels, each fitted with two 50-amp

circuit-breakers; a total of six feeders, and one street lighting panel fitted for four circuits. All feeder switches were three-pole for three-phase circuits, but were only started on single-phase circuits.

A disconnecting switch was cut into the main bus, so that with this switch closed all machines were in parallel on the bus. With this switch open two generators fed direct to the transmission line and two to the Windsor Locks feeders. This allowed voltage raising on the transmission line without interference with Windsor Locks. A watt-hour meter on the transmission panel and another on the buses for the Windsor Locks feeders gave the station output, while a recording voltmeter in full view of the attendant, with the key in the office, was a great incentive to close regulation. One of the greatest helps to the watch engineer was a frequency indicator of the vibrating-reed type. This insured a constant frequency and proved invaluable when the company began supplying energy to a large carpet mill.

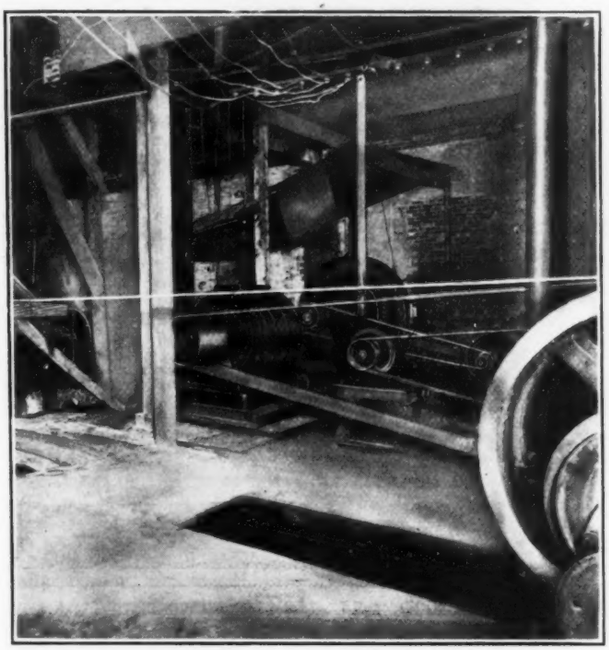


Fig. 5—Rain Sheds Over Machines During Reconstruction Period.

SUBSTATION.

In the meantime, to relieve the strain on the direct-current plant at Thompsonville the firm which had the contract for the new alternators and was late on deliveries very kindly loaned two direct-current machines to replace the overloaded generators. Excellent connections were made, the weak armature on one of the old machines going out of business the day the loaned machines came into the freight yard.

Some quick work got the machine changed so that there was only one-half hour delay in starting up. With new and larger machines available a little soliciting was started with disastrous results, as it took only about two weeks to overload the borrowed machines. A fan motor nightly and ice on Saturday nights for the pulley bearings became a steady diet until spring. As the winter load grew less the small engine was taken out and the step-down transformers set up while the old Windsor Locks single-phase switchboard was rebuilt and used as a distributing board. Temporary multiplex lightning arresters for the 6600-volt line were made up of 2200-volt arresters and these went through the first season without any trouble, giving fully as good protection as the much more expensive 6600-volt arresters later put in.

LINE WORK.

The outside work at Thompsonville was in good shape except for one street over which the transmission line came in, where the existing lines were in poor shape. At Windsor Locks the lines had been up some 14 years, apparently without repairs, and the main circuits, some of No. 8, much of No. 10, some of No. 12 and one of No. 14 had the insulation all gone except for what was hanging to the wires in graceful festoons. All kinds of insulators were used, including some borrowed from the telephone company and over which 1100-volt, alternating current, ready for business, was transmitted. The 12 circuits were replaced by four new main circuits, which were again connected at the station pole to form two main feeders, each with its own circuit-breaker on the switchboard. All side streets taken from the main north and south circuits were tapped through 2200-volt transformer fuse blocks filled with copper wire, so that any street could be cut out for rewiring without interfering with the rest of the circuit. These also proved very valuable in isolating trouble in heavy sleet storms. Nothing smaller than No. 6 wire was put up except in two cases, where special lines of No. 8 wire were run for two customers. The circuits on the main streets were cleaned up first and the poles painted, which gained the good will of the Business Men's Association. One result of using new and larger wire was that complaints of low voltage became scarce.

CHANGING OVER.

Changing over to the new generators at the Windsor Locks plant was a comparatively simple matter. The old transformers were gradually replaced with modern ones connected for 1100 volts and when all was ready a day's hard work sufficed to reconnect everything for 2200 volts and change the system from 1100 volts, 125 cycles, to 2200 volts, 60 cycles. The old shunt-box street lighting system went down and out rapidly with the change of frequency, but enough lamps held out to qualify as service until the tub transformer appeared and was connected. The meters were changed over as fast as possible, allowance on bills being made for the error due to change in frequency. Fortunately there were very few motors of any kind on the lines, so that problem was not a serious one.

At the North plant the work was more complex. Changing the alternating-current system required only a change in frequency, as the tension was already 2200 volts. The street-lighting system was, however, on 125-cycle tub transformers. Fortunately, the public lighting was on a moonlight schedule, until 1 a. m., so that all the arcs were brought in, changed over for 60 cycles, and the tub coils changed during the two nights when no light was needed. The feeders for the 115-230-volt, direct-current district allowed the center of the town to be cut into four sections, and 25-kw transformers were set at the junction point and each section cut in on the alternating-current circuits from the main station in turn. With the North plant shut down the work of moving down the good boiler and engine went ahead rapidly, and it was not long before these had taken up their work in their new home.

MOTOR LOAD.

With the beginning of the day service came the growth of the motor load—slow at first, but gradually increasing until there were several factories dependent entirely on central-station energy. Of these the carpet mill was the most interesting, as the steadiness secured by central-station service materially increased the daily yardage. Among the apparatus fed were four electric singeing machines for a yarn mill, which were worked out by the manager of the mill and the writer, and made a nice, steady, non-inductive load.

RESULTS.

All through the country are groups of small plants that form possibilities for consolidation. The chief question, of course, is, will it pay? In making the plans and calculations certain not usually included factors should be taken into consideration, the first being the class or character of service; small plants locally owned and managed can, and do, take liberties with the service which are a source of economy. An outage or low voltage is not relished; but it is all in the family and is expected and tolerated. With a consolidation and the shifting of control and management to outside parties an entirely differ-

ent standard is demanded and promises as to the quality of service made by the promoters in arranging for franchises, permits, and stock transfers have a disagreeable way of coming home to roost in the manager's office. All of this means much more expensive service than formerly. This is particularly the case where all-night service has not been previously given. In this connection much might be written on the handling of the employees taken over with the companies. Another cause of unexpected expense is the local expert, assisted sometimes by the local politician.

In this case the consolidation has been an unqualified success; the increase from September, 1906, to September, 1907, being a little over 30 per cent, and from September, 1907, to September, 1908, about 28 per cent, with the ratio of operation costs to earnings continually decreasing as the new material came into action. As figures are sometimes more satisfactory than percentages the following may be of interest: For August, 1907, the first month the station watt-hour meters were cut in on the whole system, the month's output was 23,000 kw-hours. In August, 1908, one year later, the month's output was over 40,000 kw-hours, with one large customer just starting and another ready to be connected to the motor circuits.

AN ILLINOIS FARMER'S PRIVATE HYDRO-ELECTRIC PLANT.

Favoring natural conditions have made it possible for Mr. Eli Crosiar to erect on his farm, about two miles from Utica, Ill., a small hydroelectric plant that is of unusual interest. The electrical energy supply from this installation is used entirely on the owner's premises for lighting, heating and the operation of motors. While not many farmers are so fortunately situated as Mr. Crosiar in being able to utilize the power of a small stream, the plant is nevertheless significant of the constantly increasing use of electricity by farmers in agricultural operations, as well as for enhancing the comfort of living on farms. The number of farmers who are availing themselves of electrical conveniences is constantly increasing, and apparently the time is not far distant when the well-to-do farmer will use as many of the domestic electrical appliances as the man of corresponding means living in the city.

Mr. Crosair is fortunate in that a fine stream, known as Pecumsaugan Creek, flows through a deep ravine across his farm, emptying into the Illinois River. A substantial concrete

Fig. 1—Power-House and Tailrace.

dam about 200 ft. in length and about 11 ft. high has been built across the ravine at the crest of a waterfall of 6 ft., giving a total head of 17 ft. This dam was erected by men employed by Mr. Crosiar, using gravel from a pit found on the premises. The supply of water is sufficient to develop 18 hp to 20 hp, and with the reservoir created by the dam, this power is available the year around.

About 150 ft. below the west end of the dam is located the small, but substantial power house, shown in Fig. 1. This illustration also shows the penstock and tailrace. Fig. 2 is a view of the dam from the down-stream side, giving an idea also of its substantial construction and showing the transmission line leading from the power house.

The generating equipment consists of a Leffel waterwheel, belted to a 10-kw, 900-r.p.m., 250-volt direct-current Fort

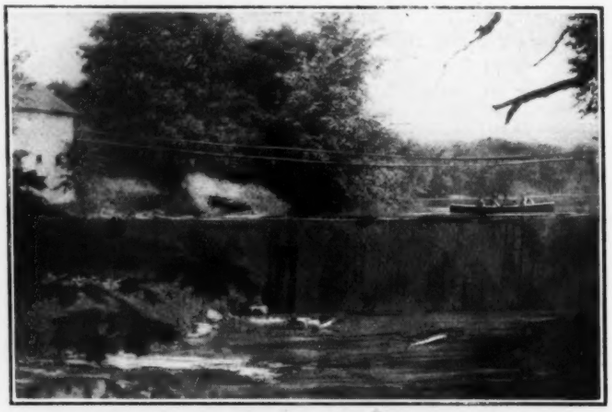


Fig. 2—Concrete Dam Across Creek.

Wayne generator, shown in Fig. 3. The power house is about 1700 ft. from the residence, with its group of barns and outbuildings. A substantial pole line, consisting of white-oak poles, cut from a timber lot on the owner's farm, connects the power house and the residence. The circuit consists of two No. 2 insulated wires, with a No. 12 wire from the generator to the field rheostat, which is placed on the switchboard located in the residence. A simple and effective device is installed to enable the people at the house to start or stop the plant, as desired, by lifting or closing the gate at the generating station, without going to the plant for that purpose. A ¼-in. stranded-steel endless cable runs over pulleys along the pole

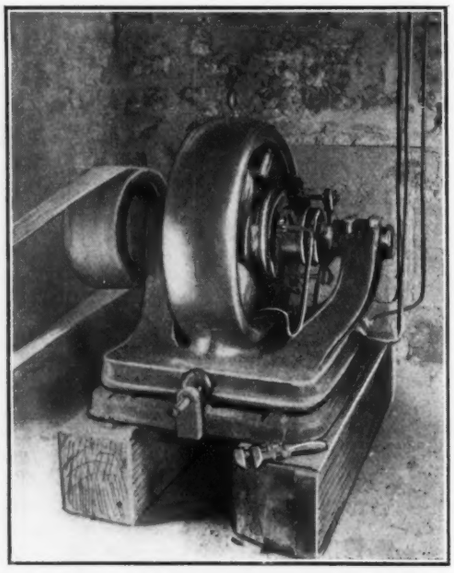


Fig. 3—Generator in Power-House.

line from the power house to one of the out-buildings near the residence. This cable passes around a sheave at the house end, and it enables Mr. Crosiar to start or stop the water-power plant by simply turning the sheave. Having started the plant, it is only necessary to step into the house and regulate the voltage at the switchboard, shown in Fig. 4, which is located in a small room in the farmhouse.

Forty electric incandescent lamps are used in the house and out-buildings. Most of these are 16-cp carbon-filament lamps, but eight 40-watt tungsten lamps are also included in the equipment for illumination. The lamps are wired two in series on the circuit, operated at 220 volts. Advantage is taken of the fact that electricity is "on tap" to install electric cooking and heating utensils, and it is also probable that an electric

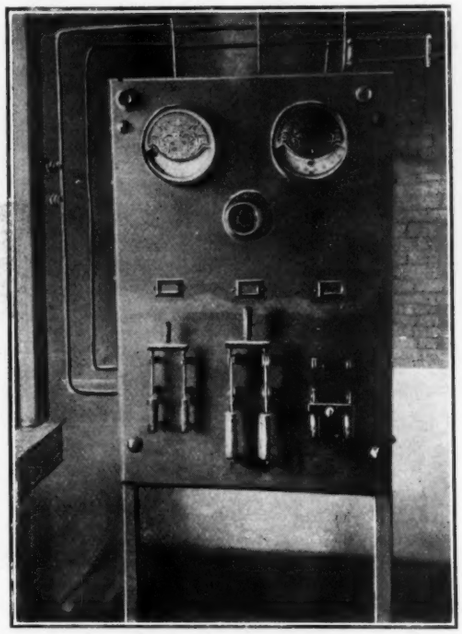


Fig. 4—Switchboard in Farmhouse.

vacuum cleaner will be employed. One flatiron forms part of the electric heating equipment.

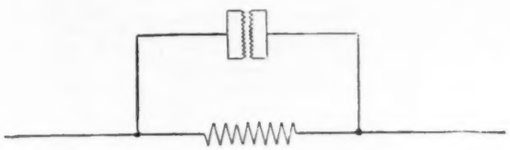
Three 220-volt electric motors are used for operating various kinds of farm machinery—that is, machinery in the various out-buildings constituting the farm center. These are Fort Wayne motors. Two are rated at 3 hp each and one is rated at 15 hp. One of the smaller motors is placed in a building near the house, and by means of shafting drives laundry machinery, a churn and a cream separator. At the dairy barn the other 3-hp motor operates an electro-pneumatic milking machine. The large motor is mounted on skids and is transported from place to place as desired. It is used in grinding feed, cutting feed, shelling corn, cutting silo, sawing wood and operating a deep-well pump and a grain elevator.

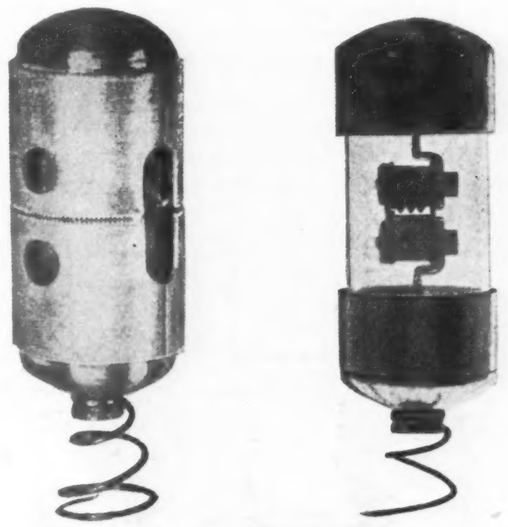
This plant has been in operation since May, 1909, and no trouble was experienced from ice last winter. It is said that the actual outlay for operation is not more than about $10 a year. The cost of installation to date, including the dam, which was built by Mr. Crosiar's own workmen as explained above, has been about $1,200. The advantage of having an unfailing electrical supply on his premises so cheaply is greatly appreciated by the enterprising farmer who owns the plant. The electrical installation was made by Mr. H. P. Grove, proprietor of the Utica Electric Light & Power Plant. The work has been done in a first-class manner throughout. The outfit requires very little attention and is giving entire satisfaction in its operation. The farmers round about evince much interest in this example of the modern way of doing farm work.

LONG INTERURBAN TELEPHONE LINES ON PUPIN SYSTEM.

The German Government early took up the development of telephone lines operated with Pupin impedance coils, and has carried on a continuous study of the operation of such lines for a number of years. In a paper read before the German Electrotechnical Society, Dr. A. Ebeling sets forth the development and present state of this art as practiced in Germany.

The first lines were installed with separate coils in each wire and without protection from lightning. However, it was very soon found out that lightning protection must be provided, and the type of protective device then adopted has not been changed in any material detail since the beginning. The type of protective device used with Pupin coils is not connected to ground, but shunts the coil, as shown in Fig. 1. It consists of an air-gap, such as used in low-tension lightning arresters, enclosed in a glass cylinder from which the air is exhausted (see Fig. 3). This glass is in turn partially enclosed by two metallic cylinders, insulated from each other and connected electrically to the terminals of the device. The edges of the cylinders are tooth-shaped, and serve to discharge any high power surges which attempt to pass through the circuit. In case the glass should break, a spring pushes the two metallic cylinders together, and thus short-circuits the device without interrupting or interfering with the telephone circuit. Fig. 1 shows the method of connecting these protective devices, and Figs. 2 and 3 indicate the construction. Fig. 4 shows a Pupin coil connected to the line and its protective device. One of the first long lines to be equipped with Pupin coils was that between Frankfort and Berlin, over a distance of 580 km. This line was made up of 2.5-mm bronze wire, and was at first erected without the coils. There were also two other lines along this route, one of 4-mm bronze wire and the other of 5-mm bronze wire. Tests were made comparing these three lines. Before the insertion of the loading coils the 4-mm and 5-mm wires were much superior to the 2.5-mm wire, but after the loading coils were inserted, talking tests showed that the 2.5-mm line was better than the 4-mm, but not quite so good as the 5-mm line. The type of coil used in this system is shown in Fig. 4. It consists of a cylindrical coil completely imbedded in iron of low permeability, the wires entering through hard-rubber terminals.





Figs. 1, 2 and 3—Diagram of Connections and Lightning Protection Devices.

The next step in the development of these loading coils was embodied in the construction shown in Fig. 5, where the coil is mounted in a vertical instead of a horizontal direction. The improvements in the construction of the coils were entirely of a mechanical nature. In the improved construction the hard-

rubber terminals were entirely dispensed with, as they had given some trouble due to breakage.

On a line between Hamburg and Koenigsberg, which was equipped with loading coils, considerable trouble was experienced with humming and other inductive disturbances from the neighboring telegraph lines. Thorough transposition of all the

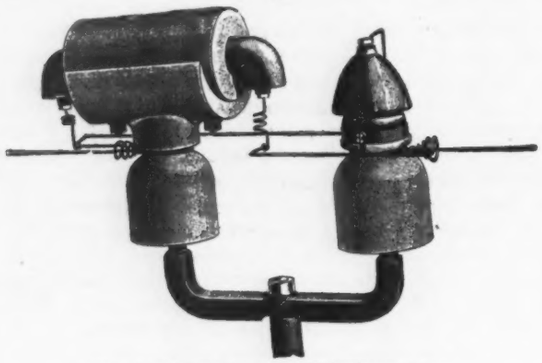


Fig. 4—Simple Coil on Telephone Line.

telegraph lines reduced this trouble, but did not entirely remove it. The telegraph lines were used for transmitting with Morse, Wheatstone, Hughes and Siemens high-speed apparatus. The Morse apparatus produced no disturbances which could be detected, while all of the others produced disturbances, but the Siemens high-speed apparatus, due to its very high frequency, was the worst. Some of the trouble was due to imperfect contact at the loading coils with the bimetallic wire, which was used on these lines. The disturbance was finally removed by the insertion of properly proportioned inductance coils in series with the telegraph lines. Although the talking qualities of the telephone circuit were much improved, the complications introduced into the telegraph circuits, on account of the inductance coils, were so undesirable that the loading coils were abandoned and removed from the telephone lines.

In the early experiments separate coils were connected in each line. Experience showed that in constructions of this kind it is very difficult to obtain perfect symmetry, and, therefore, the latest types are made up with double coils on the same iron core. A mechanical improvement over the earlier types was the substitution of metal covers for porcelain. The double coil, with its protective devices, is shown in Fig. 6. Had coils of this type been used on the Hamburg line, it is probable that the troubles due to disturbances from the telegraph lines would not have been present. Later experiments with a long 3-mm bronze line showed that such a line, equipped with double Pupin

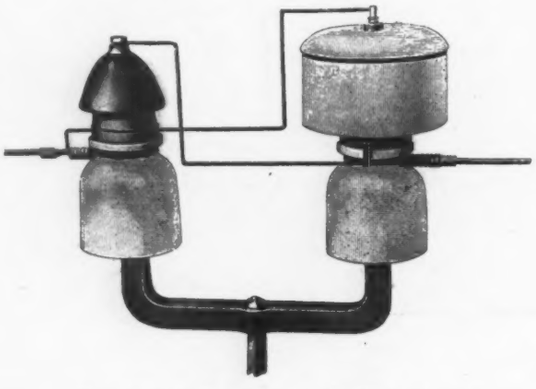


Fig. 5—Coil Arranged in Vertical Plane.

coils, was exactly equivalent to a 5-mm bronze line operating without loading coils. However, in order to be on the safe side, Dr. Ebeling assumes 4.5 mm instead of 5-mm in comparing a loaded line with an unloaded one.

In Germany, bronze wire costs 1.70 marks per kilogram, therefore, a kilometer of all metallic line of 3-mm bronze wire would cost about 220 marks, while a kilometer of 4.5 mm bronze line would cost about 500 marks. Thus there would be a saving of about 280 marks per kilometer in the cost of the conductor. From this must be deducted about 50 marks per kilometer for loading coils. Had a 5-mm line been assumed at a cost of about

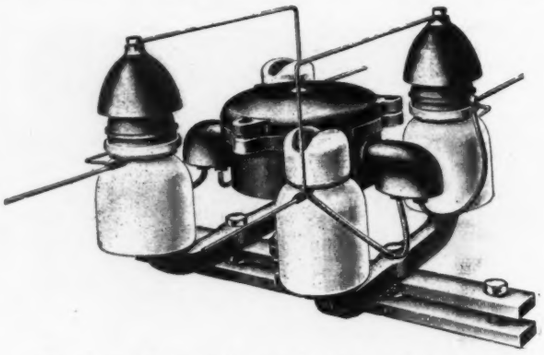


Fig. 6—Duplicate Coils and Lightning Protectors.

620 marks per kilometer, the saving would be increased from 280 to 400 marks. These figures, which are borne out by exhaustive tests, show that the use of Pupin coils reduces the cost of a given length of telephone line by at least 50 per cent.

RECONSTRUCTION OF DIRECT-CURRENT MACHINES.

Application of Commutat on Poles to Motors and Generators Already Installed.

By W. B. Clayton and James W. Craig.

IT is generally known that direct-current motors and generators equipped with commutating poles possess many advantages over similar or old-type machines not so equipped. To equip shunt, series or compound-wound, direct-current motors and generators with commutating poles is a comparatively simple matter and it is the purpose of this article first to show and briefly explain advantages of this construction and then to make clear the practical calculations and applications of these auxiliary poles and coils.

The chief advantages of commutating-pole machines are high efficiency, cooler parts, improved commutation under all

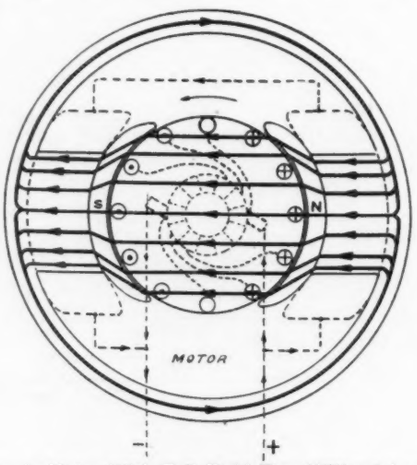


Fig. 1—Motor With Full Field Flux Without Load.

load conditions, and in the case of shunt motors better speed regulation.

The commutating poles, while adding to the copper losses of the machines, so reduce the short-circuited currents in the armature and brushes as to show high efficiency. The reduction in

the short-circuited armature current permits, not only the armature, but the commutator as well, to operate at a lower temperature. This fact renders the use of commutating poles very valuable because hot commutators tend to cause sparking due to uneven surface and high mica.

In direct-current machines not fitted with commutating poles it is necessary, in order to obtain the best commutating conditions, to give the brushes a backward lead in the case of motors and a forward lead for generators. The backward lead in a motor is given in order to place the coils that are short-circuited by brushes in a position slightly backward of the location where coils will cut no main flux. This brush setting places the short-circuited coils in a line slightly inclined from a perpendicular to the path of the main flux; thus the coils are in a fringe of flux from the main pole, where an e.m.f. is produced in them to oppose the current left in the coils when short-circuited by the brushes. The armature is an inductive circuit, and the line current in the coils, therefore, does not immediately die out when the coils pass under the brushes; it is necessary to decrease this current in an opposite direction in order to prevent sparking.

It should be noted that the direction of the path of the main flux varies with the load on the machine due to the distorting effect of the armature reaction flux. Therefore, the brushes should theoretically be reset for each variation of the load. Machines operating satisfactorily on full load will often commutate very poorly, and sometimes flash over, on light load due to the change of direction of the main flux and the consequent change of the theoretical brush position.

When the main field is weakened to accelerate the motors or reduce the voltage in generators the fringe of the flux, above referred to as necessary to decrease the currents left in the short-circuited coils, is reduced with a consequent disturbance of the commutation conditions. It is, therefore, undesirable to reduce the main field on direct-current machines unless the machines are specially designed to be thus operated and the fringe of flux has been made adequately strong to commutate the coils under the weak field condition. The accompanying diagrams will make clear the above-mentioned points.

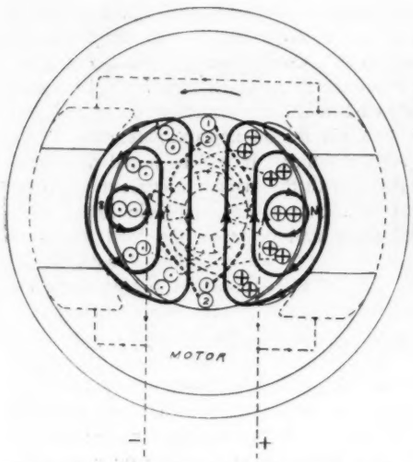


Fig. 2—Armature Reaction Flux at Full Load

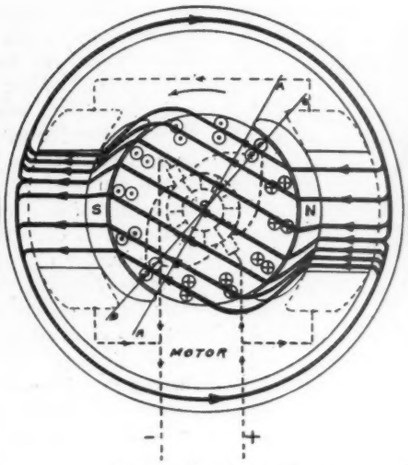


Fig. 3—Resultant Flux.

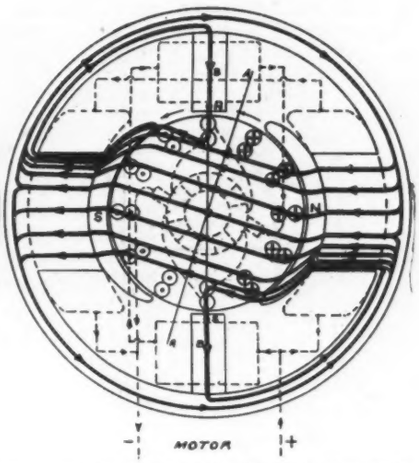


Fig. 4—Motor Fitted with Commutating Poles.

Fig. 1 shows a motor with full field flux running at no load, the armature reaction flux being negligible. Fig. 2 shows the armature reaction flux at full load, the main field flux being omitted. Fig. 3 shows the resultant flux, a combination of the main and the armature reaction fluxes. *OA* is perpendicular to the armature flux, and *OB*, slightly back of *OA*, is the proper line of the short-circuited coils for full-load condition. If either the load, and consequently the armature reaction flux or the main flux is changed, *OB* goes to a different position, thereby changing the proper brush position and causing the brushes to be incorrectly set.

The commutating poles should be set midway between the main poles so that their flux acts in the same capacity as the fringe of flux from the main poles previously referred to. The field coils on the auxiliary poles are connected in series with the armature in such a manner that the commutating pole flux opposes the effect of the armature reaction. The flux of the poles then increase and decrease in strength with the armature current and is, therefore, able to offset the effect of the armature reaction under their faces which on these machines is the zone of commutation, and the brushes are always set so

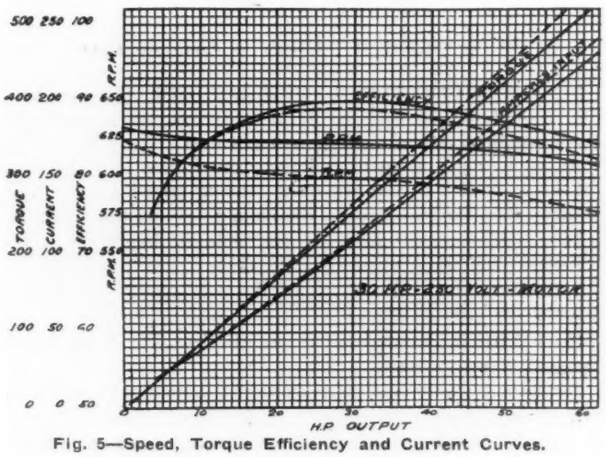


Fig. 5—Speed, Torque Efficiency and Current Curves.

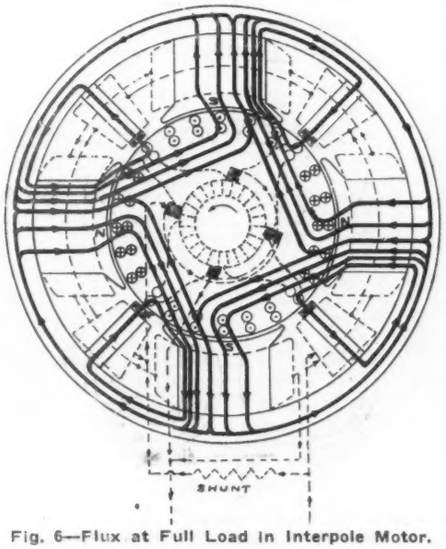


Fig. 6—Flux at Full Load in Interpole Motor.

as to short-circuit the coils under the commutating poles. The backward motor and the forward generator leads in the setting of the brushes are avoided. Fig. 4 shows a motor fitted with commutating poles indicating the setting of the brushes. It will be noted that *OB* runs through the commutating poles and short-circuited the armature coils.

In shunt-wound motors equipped with commutating poles the speed can be adjusted by shunting the commutating field-

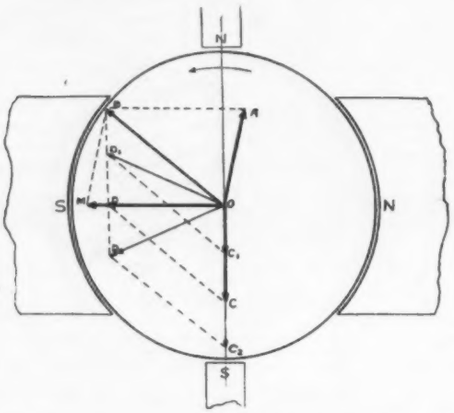


Fig. 7—Vector Space Diagram of Two-pole Shunt Motor.

coil current to give practically a "flat" regulation. A drop in speed from no-load to full-load of only 2 per cent is perfectly feasible; closer regulations are undesirable because a commutating-pole motor becomes unstable when the speed curve is too near a horizontal line.

Fig. 5 shows the speed, torque, efficiency and current curves for a 30-hp commutating-pole motor. The full lines show curves for the commutating-pole construction, while the broken lines show curves for the same motor with the commutating poles removed. Commutating poles should always be removed when not in use, because when they are not active they offer a low-reluctance path for the armature reaction flux and, therefore, cause extra distortion of the main flux and a consequent deleterious effect on the commutation. The commutating-pole construction increases the speed of motors by from 5 per cent to 8 per cent on small machines and from 2 per cent to 5 per cent on larger sizes; it also lowers the voltage of generators by similar amounts. The increase of speed in motors and the decrease of voltage in generators is due to a

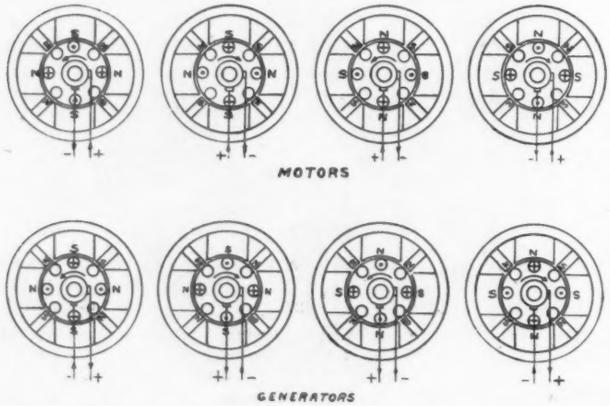


Fig. 8—Relation Between Polarity, Armature Current and Rotation of Motors and Generators.

reduction of the main flux by the interception of the commutating pole flux. The lower the main flux densities, the lower is the percentage of change.

Fig. 6 shows the flux at full-load on a four-pole motor fitted with commutating poles; it should be noted that one-half of the main flux circuit is parallel to the commutating pole flux thereby increasing the reluctance of the main flux path for that part of the circuit and consequently lowering the main flux and increasing the motor speed or lowering the generator voltage.

Fig. 7 shows a vector-space diagram of a two-pole shunt-wound motor. The full lines in the parallelograms represent the direction and magnitude of the different fluxes. *OM* shows the main flux with no armature current. *OA* is the armature reaction flux, which shows a slight lag due to the hysteresis effect in the armature iron. Combining *OM* and *OA* gives *OB*, the path of the resultant flux, which requires a backward lead on motors not fitted with commutating poles, because short-circuited conductors should be approximately on a line perpendicular to the resultant flux. It will be noted that while *OM* is constant, *OA* varies with the armature current up to the saturation of the iron of the armature and pole faces. The main flux is distorted more and more as the load increases. Now consider *OC* of such length when combined with *OB* as to make *OD* fall on *OM*. This proportion brings back the main flux to the no-load direction with references to the short-circuited coils, thereby making the backward lead unnecessary. It will be noted that the resultant flux *OD* is less than *OM*, thereby increasing the speed. It is of importance to have *OC* correct. If the commutating pole flux were OC_1 or OC_2 the resultant flux would be OD_1 or OD_2, requiring, respectively, a forward or backward lead, which is undesirable on a commutating motor. Fig. 8 shows the correct relation between the polarity of all of the fields, the direction of the armature current and the direction of rotation for both motors and generators.

THE ADDITION OF COMMUTATING POLES TO OLD MACHINES.

It is good practice to use as many commutating poles as there are main poles. The pole-pieces should be made of cast-

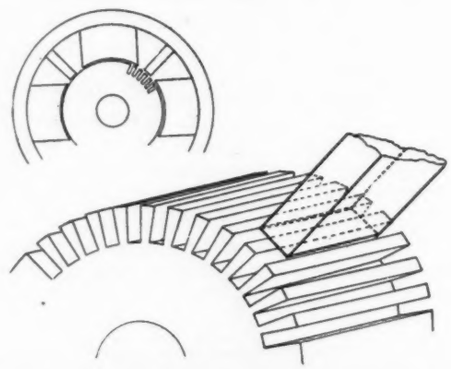


Fig. 9—Relation of Interpole to Armature Slots.

steel forgings or sheet-steel punchings riveted together. Cast iron should not be used as its capacity for carrying flux is much less than that of steel or wrought iron. The poles should be of such length as to extend from the frame, to which they should be bolted, to the armature, leaving an air-gap not less in depth than the gap between the main poles and the armature.

The cross-sectional area of the pole is important. The thickness should be approximately three times the width of the armature slot. The width of the pole should be not less than 70 per cent of the armature-core iron. The face of the pole need not be bored, but can be left flat. Fig. 9 illustrates these points.

The commutating-pole coils should be wound with insulated wire or bare copper wire strap with varnished cambric between layers. Terminals or ends of straps should be brought out on the ends of the coils, not on the sides, where interference with main coils will result. Wire or strap should be wound on a suitable insulating box and then dipped in black japan. Black coils run cooler than white.

The cross-section of the wire or strap depends on the value of the armature current. The current density should be from 1250 amp to 1350 amp per square inch.

The formula for calculating the number of turns per coil is: $T = (0.6 \times W \times S) \div (P \times B)$. Where W = number of conductors per armature slot, two or more wires in multiple being counted as one conductor; S = number of slots; P = number of main poles; B = number of circuits in armature. $B = 2$ for all series-connected armatures and for multiple-connected armatures $B = P$.

Multiple-connected armatures are generally not used for

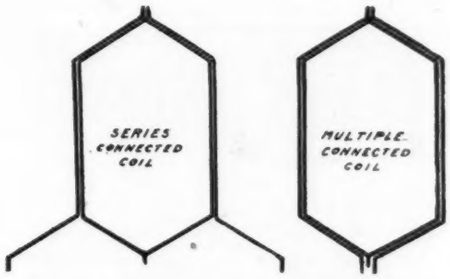


Fig. 10—Two-turn Series and Multiple Coils.

motors smaller than 50 hp. On large armatures multiple connection can be detected, by the presence of equalizing rings on the end of the armature opposite the commutator. The equalizing rings are never found on series-connected armatures. A sure way to determine the difference between series and multiple connection is to examine the coil leads. Fig. 10 shows a two-turn series coil and a two-turn multiple coil. The leads from the series coil go to commutator segments widely separated, while the leads from a multiple-connected coil go to adjacent commutator segments. In a two-pole machine the number of circuits is always equal to two—that is $B = P$.

As an example illustrating the use of the above formula, consider a four-pole motor having 59 armature slots with 26 conductors per slot, the armature being series-connected. Then $T = (0.6 \times 26 \times 59) \div (4 \times 2) = 115.5$.

One should always calculate to the nearest half turn. The armature current can be determined from the nameplate, which gives the value of the full-load current. For a shunt-wound motor, the armature current equals the load current less the field current. In a shunt-wound generator the armature current equals the load current plus the field current. The value of the field current can be ascertained by means of an ammeter.

Fig. 11 shows the connections for a shunt, series and compound motor, and also the connections for generators. In this illustration $M\,Sh$ = main shunt-field circuit; $M\,S$ = main series-field coils; $M\,C$ = main compound series-field coils; C = commutating-field coils; Sh = shunt; $R\,H$ = rheostat.

After the connections have been made, the machine should be operated with a small amount of current, a pocket compass should be used to determine if the polarity is correct. The brushes should then be so set as to short-circuit the conductors under the commutating pole faces. The machine should be run as a motor, if possible, at light load to determine the exact setting of the brushes to give the same speed in either direction of rotation. The brush position should be carefully marked, and the machine should subsequently be run with the brushes in this position. This setting of brushes should check very closely with the preliminary setting of the brushes referred to above. There should be connected a German-silver shunt or water rheostat around commutating-field coils, and the machine should be operated at full load and then double load if possible, the shunt being adjusted to give the best results; final adjustments should be made with the machine hot. The shunt should be arranged for the best commutation without making the machine as a motor unstable. Too much commutating-pole field flux will cause a motor to "hunt" or race. During the trial setting of a motor an attendant should always be stationed at the main switch to open the circuit at the first signs of hunting. No trouble of this kind is experienced with commutating-pole generators. After the resistance of the shunt has been adjusted a permanent shunt resistor can be made up and installed in circuit in place of the temporary shunt, or the commutating-pole field coil can be removed and turns taken off to give the correct field strength. The correct number of turns can be determined for the values of the necessary current in both commutating-field coils and the temporary shunt when the machine is operating at or near full load after a run of sufficient length to acquire its normal temperature. The new number of turns T_n can be calculated by means of the formula: $T_n = T_1 T \div (T_1 + T_2)$, where T_1 = current in the compensating-field coils, T_2 = current in the shunt around these coils, and T = the number of turns in one of the original coils.

As has been mentioned above a commutating-pole motor will "hunt" if incorrectly adjusted. Hunting on all types of commutating-pole motors should be carefully guarded against, because serious injury may result, both to the attendant and to the machine from any excessive speed resulting from the hunting action. Hunting is caused by the commutating field overpowering the main field, the motor running as a series machine with an excessive backward lead, thus causing destructive speed. In practice, fuses would protect a motor from injury, because the fuses, if of proper size, would blow from excessive current before the motor attained a destructive speed. A commutating-pole shunt motor subject to sudden heavy loads is more liable to hunt than is a similar motor subject to a steady load. A sudden load increases the commutating field suddenly, while the main field is unchanged thereby causing an unbalancing of the fields. A motor once properly adjusted will run indefinitely with good results.

Commutators should always be turned and put in good condition when introducing the commutating-pole construction. The brushes of a commutating-pole motor should never be moved after once being set. In some special cases where a motor runs only in one direction, a slight forward lead makes a motor more stable. The brushes of a commutating-pole generator may be moved slightly backward or forward as far as is consistent with good commutation in order to give the necessary voltage change.

The addition of commutating poles opens the way to run motors on higher speeds or generators at reduced voltage and

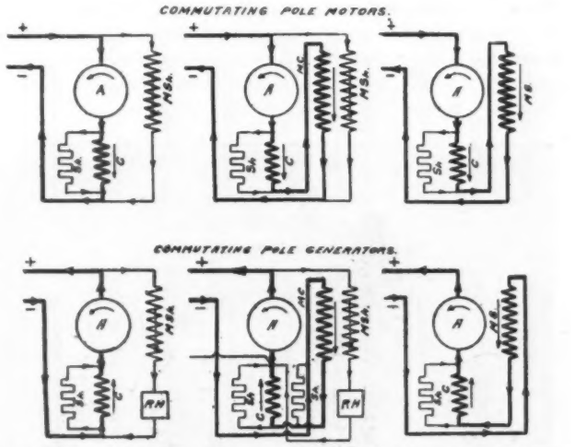


Fig. 11—Connections of Shunt, Series and Compound-Wound Motors, and for Generators.

full-load current by weakening the main field while retaining good commutation. The field of commutating-pole motors should never be weakened until two very important factors are accounted for. The armature and the commutator should be able to withstand the added centrifugal strains, and the motor should be carefully tested for hunting at the extreme weak field condition and run at not less than 50 per cent overload. Armatures and commutators as usually constructed should not be run at a peripheral speed of over 5000 ft. per minute.

When the foregoing suggestions are carefully followed, machines that have previously given trouble from poor commutation or excessive armature heating will run like new and repay many times over the cost of adding the commutating poles by a lower energy consumption and a lessened maintenance charge.

ELECTRICALLY DRIVEN OIL-PRESSURE SET.

By C. E. Ingalls.

In San Francisco the cost of crude oil is low when compared with the cost of coal. As a natural consequence many of the buildings heated by steam are equipped with boilers fired with oil. The Marvin Building has an oil-burner outfit that is typical of the better class of installation. The oil is stored in a tank located directly underneath the sidewalk, and is drawn through a strainer to the pump, the strainer being so constructed that it can be taken apart and cleaned very easily. From the pump the oil is forced under 10 lb. pressure through an air and oil chamber, an oil heater and the oil burner. The air and oil chamber reduces to a minimum any pulsation that may be caused by the pump. The heater consists of a 1-in. pipe containing oil and surrounded by steam enclosed in a 2-in. pipe. Steam is taken from the top of the boiler through the 2-in. pipe and is then returned to the bottom of the boiler. The regulating valve is an ordinary globe valve operated by a lever, the lever being raised by a pressure regulator, when the pressure of the boiler rises above a predetermined value and vice versa. The raising or lowering of the lever closes or opens the regulating valve in the pipe line, and by means of this mechanism the oil plant is made entirely automatic in operation. The burner is of the Jarvis type, manufactured by the Jarvis Steam & Electric Engineering Company, of San Francisco. If for any reason the pressure in the oil line rises slightly above normal, a relief valve opens and enough oil is forced through a pipe returning to the tank to reduce the pressure to normal.

Air under 2 lb. pressure is used to vaporize the oil as it leaves the burner. This air is drawn from over a rotary air blower and is forced through an air chamber directly to the burner. A relief valve is connected to the air chamber and is set to operate at 2½ lb. pressure.

The oil pump and air blower are driven by an electric motor. The shafts of the pump, blower and motor are connected together by couplings, all three machines being mounted on a common cast-iron base. The motor is of General Electric Company's make and is rated at 1¼ hp when running at 475

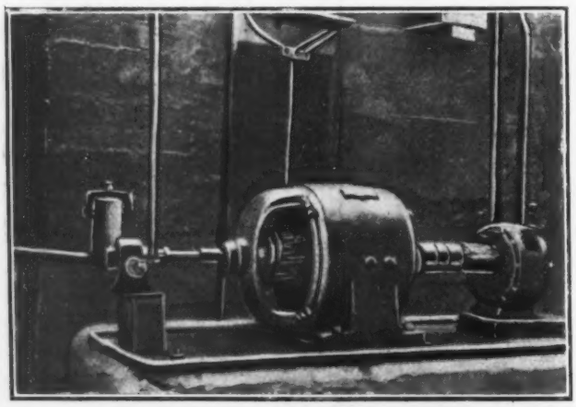


Fig. 1—Motor-Driven Pump and Blower.

r.p.m., its normal speed. To give greater flexibility to the set the motor is furnished with an armature-type speed regulator. The latter is used for starting the motor and varying its speed when desired. Under normal operating conditions in this plant the motor requires 5¼ amp at 230 volts.

Until recently coal was employed in the furnaces of the boiler. Approximately 8 tons of coal, costing $12 per ton, were burned in one month. With the oil outfit approximately 25 bbl. of oil, at $1.10 per barrel, are being burned. The saving through the use of oil is, therefore, considerable; for with 8 tons of coal at $12 per ton, plus a charge of $5 for ash removal, the monthly cost, using coal as fuel, was $101. The 25 bbl. of oil used monthly represented an outlay of $27.50, and the energy for operating the motor amounted to 157 kw-hours monthly, which, at the rate of 3.5 cents per kw-hour, cost $5.50, bringing the total cost to $33. The saving per month,

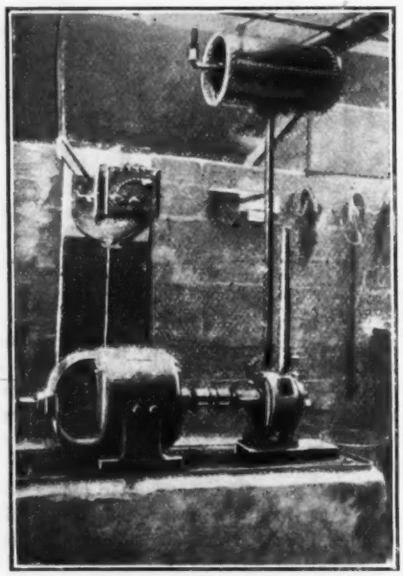


Fig. 2—Motor-Driven Pump.

therefore, by substituting oil for coal, was $68. When coal was used the man tending to the boiler-room devoted five hours of his time to keeping up steam and the balance to janitor work. Now he devotes nearly all of his time to janitor work as the present outfit, being automatic, requires very little attention.

DESIGN AND INSTALLATION OF SWITCHBOARDS.

At a recent meeting of the Pittsburgh Booster Club, Mr. Saul Lavine presented a paper sketching the evolution of switchboard design during the past 20 years and concluding with the following requirements of modern design and installation:

A switchboard should have means for positively disconnecting every feeder from the system under all conditions of load, and similarly for disconnecting every generator from the system under all conditions of load. Under most conditions of operation there should be automatic means for cutting off all current from a given line or section of the system during emergencies, as, example, upon a short-circuit.

In a system of large capacity it is best to separate the switches from the switchboard proper and often individually in fireproof compartments. The whole switchboard should be constructed with special reference to preventing the spread of electrical trouble from one portion of the board to another. Busbars should be so located that the probability of short-circuits through carelessness is very remote.

In very large stations, it is best to make the busbars remote from the switchboard itself and install them in fireproof compartments, separating the negative and positive buses. Separation for the sake of protection is carried so far to-day that it is common practice to erect a separate building or structure for high-potential switches and busbars. The busbars are frequently sectionalized so that different generating units or feeders can be operated either independently or in conjunction with the main system.

All devices from which flashes or arcs might emanate, such as circuit-breakers on direct current, or low-voltage alternating

current, boards or expulsion type fuses, should be so placed that such areas or flashes cannot start trouble. The use of all combustible materials should be strictly avoided; there should be nothing on or near these switchboards upon which flames could feed.

In selecting the devices for use on a switchboard, the utmost care should be given to their proper insulation, to the extent of rupturing capacity, as well as current-carrying capacity. It must be remembered that a switch ordinarily controlling a relatively small energy output will, in case of trouble, be called upon to open the entire generating capacity back of it.

The following general rules should govern the installation of switchboards:

Ample space should be provided in front and back of the switchboard, so that the operator will have plenty of room, and there will be no necessity of crowding the switchboard. Allowance should be provided that extensions may be made in the most convenient manner, both as regards the switchboard itself and the wiring to the machines and feeders. A switchboard should stand on a level foundation, which may be made of hard wood, or iron, in the form of "I" or channel beams.

Switchboards should be placed where the operator will have a commanding view of the station, this rule applying only to that part of the switchboard containing the instruments and controlling switches, or handling of switches, etc. If electrically operated switches are used, they will not necessarily be placed near the controlling board, but should usually be placed with regard to convenience of connections and safety from fire in handling.

TRANSFORMER FOR LOW-VOLTAGE CIRCUITS.

By C. Nosrac.

For ringing electric bells, operating annunciators, and running small electrical toys, the most satisfactory source of power is a small transformer operated from the 110-volt, 60-cycle circuit. A device of a character such that it can readily be made by an amateur is herewith illustrated and described.

The transformer is of the closed-core type, and is built up of 35 laminations punched or cut from 0.020-in. armature iron and of the dimensions shown in Fig. 1. The core is assembled by slipping the center leg of the punchings through the coil, first one from the left-hand side and then one from the right-hand side, in order to stagger the break in the center leg.

The coil is wound over a wooden block a trifle larger than the center leg of the core, first insulating the block with five

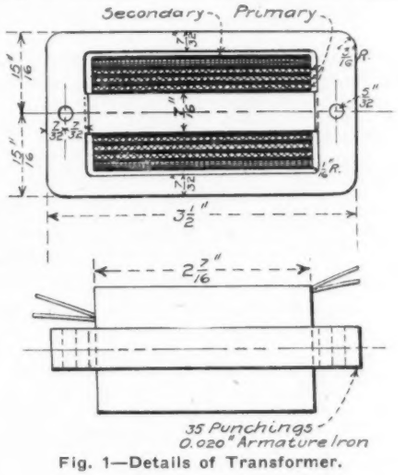


Fig. 1—Details of Transformer.

or six thicknesses of oiled paper, and over this winding 3120 turns of No. 36 double silk-covered magnet wire in four sections of 780 turns each, insulated between sections with two layers of oiled paper. Outside of this primary coil wrap five or six thicknesses of the oiled insulation paper and then wind four layers of 71 turns each with No. 25 double cotton-covered magnet wire. Wrap the whole coil neatly with black pebbled bookbinder's cloth, and then thoroughly impregnate the coil by boiling in insulation varnish.

After drying, the laminations may be assembled in the coil as shown in Fig. 1, and the whole unit is ready for fastening in its case, details of which are shown in Fig. 2. This case is

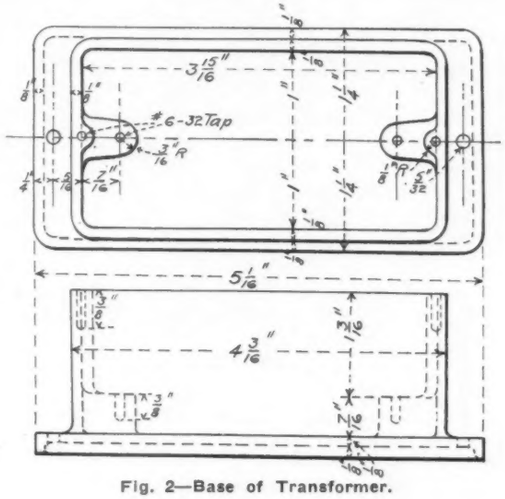


Fig. 2—Base of Transformer.

to be made of cast iron and the pattern is of such form that it may be readily made by anyone slightly familiar with the use of carpenters' tools. The cover is shown in Fig. 3, and the terminal binding post construction is shown in Fig. 4. These

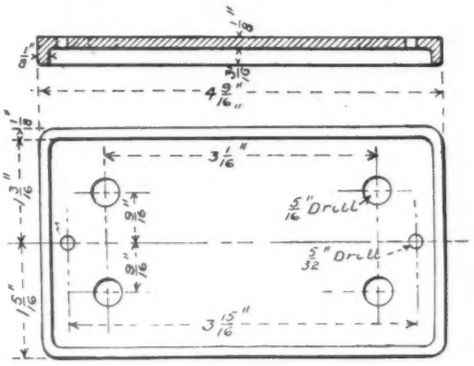


Fig. 3—Cover of Transformer.

binding posts are to be mounted in the four large holes shown in the cover, and two of them are connected to the primary windings of the coil; the other two are connected to the secondary windings of the coil within the case. They are insulated from the cover by a bushing of hard rubber.

The primary and secondary binding posts should be plainly marked by some suitable designating device to prevent the secondary terminals of the transformer from being connected across the 110-volt line, which would result in the destruction of the coil.

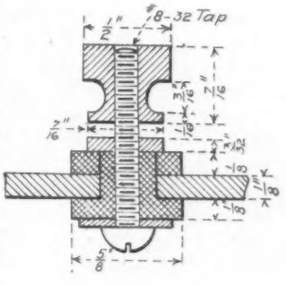


Fig. 4—Binding Posts.

To use this transformer it is only necessary to connect the bell wiring, which would ordinarily run to the batteries, directly to the secondary binding posts. The losses are exceptionally small, and the instrument is designed to be left on the line continually. The case may be finished in black japan or in any way desired by the builder, and when completed the device will be found to be very satisfactory and neat appearing.

TESTS OF GROUND CONNECTION.

At the Iowa Electrical Association convention, on April 20, a committee consisting of Mr. Thomas Sloss, of Ames, and Prof. F. A. Fish presented a report giving results of tests on various types of terminals used for grounding the secondaries of transformer circuits. The terminals were embedded during August, 1909, in an area of about 40 sq. ft. and 200 ft. from the power house of Iowa State College at Ames. The soil is a black muck nearly always damp to within 3 ft. or 4 ft. of the surface.

The tests were intended mainly to determine the relative resistances of the different kinds of terminals and indicate nothing as to the performance of ground connections under different conditions of soil and dampness. There were 13 different kinds of ground connections, each one being duplicated to afford a check on the results. The two terminals of each pair were about 5 ft. apart. Each ground plate used was 12 in. sq. The arrangements were as follows, indicated in the accompanying table. It was found easier to drive the pipes without points than with them.

Measurements on the ground connections were begun Jan. 28, 1910, and taken every four or five days. Their resistance was tested with ammeter and voltmeter, 60-cycle, single-phase current. The connections to the plate grounds were made by soldering No. 10 wire to the plates.

The resistance of each pair of ground connections was measured in series and each was also tested in series with the college water-main system. The resistance of each ground connection was determined as follows: The resistance of each pair of ground connections taken in series was subtracted from the sum of the resistances taken with each one of the pair in series with the water pipes. The result is twice the resistance of the water-pipe system. This was, therefore, divided by two and subtracted from the resistance found with the ground connection in series with the water pipes. The result is the resistance of the ground connection being tested.

RESISTANCE TESTS OF GROUNDS.

	Number 1		Number 2		Average of 12 Values		Mean of 1 and 2	Relative Value
	Max.	Min.	Max.	Min.	1	2		
Iron Plates, 5 ft. 6 in. deep in earth	9.95	7.55	7.75	6.03	8.7	6.72	7.71	1.17
" " " " " " charcoal	9.25	7.20	9.85	7.50	8.17	8.45	8.31	1.26
Copper " " " " " earth	7.60	6.00	8.65	6.90	7.50	7.70	7.60	1.15
" " " " " " charcoal	9.75	7.85	9.55	7.73	8.55	8.46	8.50	1.29
Aluminum Plates, 5 ft. 6 in. deep in earth	9.85	7.20	9.80	7.15	8.37	7.95	8.16	1.24
" " " " " " charcoal	11.63	10.00	10.50	4.78	10.95	6.61	8.80	1.33
1½" Galvanized Iron Pipe, 6 ft. deep in earth	10.00	8.13	8.70	6.68	8.71	7.29	8.00	1.21
" " " " " " " charcoal	14.55	11.50	13.50	9.90	13.62	11.53	12.58	1.90
" " " " " 3 ft. " " earth	19.40	15.00	28.10	18.40	17.70	24.50	21.10	3.20
" " " " " 10 " " " "	8.68	5.20	7.70	5.25	7.12	6.09	6.60	1.00
" " " " " 15 " " " "	8.20	6.15	7.35	6.20	7.08	6.51	6.78	1.03
Garton-Daniels Plates, 5 ft. 6 in. deep in earth	10.60	4.53	9.50	7.85	6.48	8.56	7.52	1.14
" " " " " " "	12.70	10.05	13.45	10.90	11.69	11.78	11.73	1.78

The table herewith shows the maximum and minimum values of resistance obtained for each ground connection, the average of 12 results obtained for each between Jan. 28 and April 1, 1910, the mean value for the two ground connections of each pair and the relative values of the mean, taking the lowest value obtained as unity. The lowest resistance was obtained with the galvanized iron pipe.

Attention was called to the great difference between maximum and minimum values for one of the aluminum plates in charcoal and for one of the Garton-Daniels plates in earth. The committee was not able to account for these results.

In discussing the paper Prof. A. H. Ford said that the unexplained variation in the Garton-Daniels ground connection shown by the table might be accounted for by a bad joint between the pipe and the cast-iron plate. In the case of the aluminum plate it is possible that the salts in the surrounding earth moisture might have caused an insulating coating. Professor Fish said that a curve showing variation of resistance from day to day on any one ground would be very jagged and irregular. Prof. L. B. Spinney said that the report coincides with the tests recently published by Dr. Steinmetz in that the pipe ground connections were found to be best.

Mr. A. L. Dodd related experience with imperfect ground connections. In one case where a ground connection was made in a mudpuddle near the city watering trough, horses standing in the puddle would get shocks whenever they touched the fountain. Mr. Thomas Crawford reported similar trouble at Clinton due to imperfect grounding. Mr. J. R. Cravath said that these troubles were caused by the fact that the ground rods or plates were not in moist earth except at the surface; therefore, anyone getting into a position to form a path between the surface water and the city water pipes would be shocked.

SUPERHEATED STEAM AND SUPERHEATERS.

A paper outlining the economies resulting from using superheaters was presented by Mr. D. S. Jacobus at the annual meeting of the National Association of Cotton Manufacturers, held in Boston on April 27 and 28. The author said that the saving may be from 3 to 5 per cent for 100 deg. of supertemperature for large and highly economical turbines and engines in which there is a high ratio of expansion, and reach from 10 to 25 per cent for 100 deg. of supertemperature for less economical prime movers. Tests have proved that as high an efficiency is obtainable with a boiler and properly designed superheater as with one supplying saturated steam. The author discussed at length the reasons why there is no falling off in efficiency on account of the introduction of superheaters inside boiler settings. In tests made by him on the Pacific Coast with oil-burning boilers, efficiencies as high as 83 per cent were obtained, the steam being superheated by 100 deg. Fahr., and careful heat balances indicated a margin of only 2 per cent for radiation losses, etc. The gases in the boiler must not be allowed to depart from their normal path, however. There are no greater operating difficulties with superheated steam than with saturated steam, where the piping is properly designed and installed, up to about 200 deg. supertemperature. The experience with steel castings in superheated steam work has demonstrated that they are good for such service. A constant degree of supertemperature is seldom required. Where a number of boilers are connected in a battery, the variation in supertemperature for the combined flow of steam in the main leading to the engine will be much less than the variation at the individual boilers.

With an independently fired superheater it is possible to overcome some of the variations due to the changes in load. Overheating usually occurs when an accident happens which requires the immediate shutting down of the plant. If the fireman becomes excited he is apt to forget to open the firing doors to allow cold air to pass through the superheater, or to cover up the fires to reduce the heat; hence, the superheater may become burned, or where there is a slight flow of steam to an auxiliary engine or pump, the temperature of the steam may be so high that it will cause trouble.

LETTERS ON PRACTICAL SUBJECTS

AN IMPROVISED TACHOMETER.

The electrical tachometer is recognized as one of the most accurate and reliable, but the cost of the instrument often bars its use. A rotary engine recently tested at the Colorado School of Mines had to be run at all speeds from 400 r.p.m. to 1000 r.p.m. and the brake horse-power maintained at a constant value throughout this range of speed. This requirement made it necessary to adjust the speed of the engine—by means of the cut-off—to a predetermined value corresponding with the assumed horse-power and weight of the Prony brake. With the common revolution-counter this adjustment would be an almost endless task and some form of tachometer was necessary.

At the time of the test no tachometer was available, and, therefore, a ½-hp, 110-volt direct-current motor having a normal speed of 1650 r.p.m. was belted to the engine shaft, and the field circuit was left open. The armature was connected to a voltmeter having a range of 0 volt to 15 volts by tenths. Various speeds of the engine were found by a revolution-counter and the corresponding voltmeter readings were noted. A curve was plotted showing the relation of speed and volts; as expected, this calibration curve was a straight line through the origin—1000 r.p.m. was found to give 13.33 volts. From this curve the speed at any instant could be read at a glance and the engine could be brought to any desired speed. After several days' use, when the tachometer was tested again, it showed no change, the residual field of the motor having remained constant. The power required to drive the small armature was a negligible portion of the power developed by the engine tested, and the apparatus was very satisfactory.

Golden, Col. WILLIAM J. HAZARD.

SCHEME FOR ELIMINATING ENGINE OSCILLATIONS.

In an article by Mr. Warren H. Miller, entitled "Gas-Engine Alternators in Parallel," in the first issue of January, 1910, is the following statement: "If two people count readings (on the ammeter) simultaneously it will be found that when one calls 'right,' the other will be calling 'left' (and this is also true of the ordinary periodic swinging), showing that as one machine is taking the load the other is dropping it."

For several years I have been trying to devise some plan for retarding the "fast" engine when it moved ahead of its

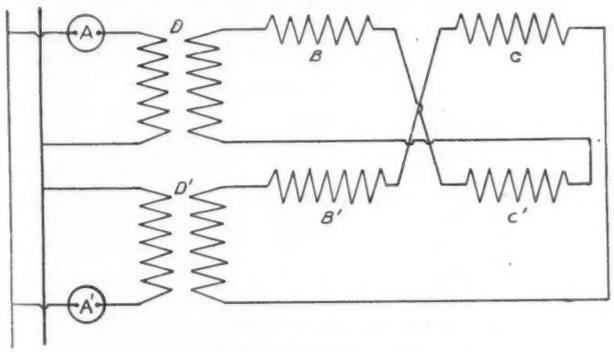


Diagram of Connections.

normal position, but it was not until I had read this statement that I succeeded in reducing the device to anything like a practical one. The principle of the device as based upon this statement is very simple, if the needle of one or both of the ammeters could be connected to the governors of the engines in such a manner that when either engine moved ahead the supply of steam or gas would be cut off, it is evident that the oscillations of the machines would be greatly reduced or even entirely eliminated. Herewith is given a description of the device for accomplishing this result, which I have thought might be of interest to those engaged in this field. I would also be pleased to get the opinions of engineers who have made a study of this subject concerning the practicability of the device.

The device consists of two solenoids, of the stopped, iron-clad variety, mounted on the extremities of an insulating tube of sufficient length to leave a considerable space between them, and which contains a sliding iron core of such dimensions that it can move freely between the two stops at the ends of the tube. As these coils are excited with alternating current, it is evident that when both are excited to an equal extent the core will take a position midway between the two stops, but if the current in one is increased the core will move toward the stronger coil. In actual practice the core is connected to the governor of its engine in such a manner that when it moves in one direction it tends to retard the latter, while it accelerates it when it moves in the other.

Each one of the engines is provided with one of these devices, which is mechanically connected to its governor as mentioned, while each alternator has, connected in its work-circuit, a small series transformer, the secondaries of which are connected to the coils of the regulators, as shown in the sketch, where *A, A'* are the alternators, *B, B'* are the retarding coils of the regulators, *C. C'* are the accelerating coils of the same, and *D, D'* are the series transformers.

The working of this device is as follows. Suppose that machine *A* takes more than its share of the load, due to its getting ahead of *A'*. This will strengthen the current in the secondary of the transformer *D* and weaken that in *D'*, which, in turn will strengthen coils *C'* and *D'* and weaken coils *C* and *B'*. It is evident that this will cause the core of solenoid *BC* to move to the left, while that of *B'C'* will move to the right. It is easily seen that if the cores were properly connected to the governors of the two engines, the fast one would be retarded and the slow one accelerated, thus bringing them together again.

In the case of more than two machines the right-hand coil of each regulator would be replaced by a number of independent windings, equal to the number of machines minus one. Each of the transformers would be connected to the left-hand coil of its own regulator and to one coil on the right-hand side of each of the other regulators.

Changes in the load on the work-circuit do not affect the engines as the coils on both sides of the regulators are strengthened alike, but as soon as any machine gets ahead of the rest it takes some of the load from the other machines, thus affecting its regulator and consequently its prime mover.

This device can be used in connection with direct-current machines by substituting for the series transformers a small resistor for diverting a small portion of the current through the solenoids. Used in this manner it would tend to keep the voltage at the proper value by regulating the speed. It could also be used to regulate the field excitation.

White River Junction, Vt. HAROLD W. BOURLET.

METHOD OF SEPARATING LOSSES OF ELECTRICAL MACHINES

In the ordinary rated-motor method of separating the losses of electrical machines, the machine to be tested is belted to a small motor whose output is not very much greater than the total stray power losses (friction plus windage plus iron losses) of the machine under test. By means of this small motor the machine under test is driven at normal speed, all of its electrical circuits being open. Then the power input of the small motor, multiplied by the efficiency of the small motor, together with its belt transmission at that particular load, gives the power spent in overcoming the friction plus windage of the machine under test. A second run, made with full normal field excitation, enables the total stray power loss to be found. By subtracting the friction and windage from the total loss the iron loss is obtained.

A disadvantage of this method lies in the necessity of knowing the efficiency of the auxiliary motor together with that of

the belt transmission. A method which the writer believes to be new and which does away with the necessity of knowing the efficiency of the motor or of the transmission is as follows:

Belt the machine to be tested to a small motor whose output should be not very much greater than the total stray power losses of the machine to be tested (though in this method the error likely to be introduced by using a larger motor is less than would be introduced in the ordinary rated motor method). By means of this small motor drive the machine to be tested at normal speed, all its electrical circuits being open. Note the readings of ammeter and voltmeter in circuit with the small motor. Now put full normal excitation current through the field spools of the machine under test. This reduces the speed of the auxiliary motor. Put a rheostat in series with the armature of the machine under test and pass current through the armature so as to bring the speed again to normal value (no change at all being made in the adjustments of the auxiliary motor). The instruments in circuit with the small motor will now read the same as in the first run. Note the power input of the machine under test. This input minus the I^2R losses in the armature and brushes gives the iron losses of the machine.

This is seen at once by considering that the small motor is doing the same amount of work in the second run as it did in the first—that is to say, it is covering friction and windage. And since the machine is now running at normal speed with normal flux it follows that normal iron losses are occurring. These must be covered by the power put into the armature. The iron losses having thus been found the total losses may be deduced from the results of a separate no-load run upon the machine tested, the auxiliary motor having been disconnected by throwing off the belt. The difference between the total losses and the iron losses gives friction plus windage. In this method it is unnecessary to know either the efficiency of the small motor and its transmission, or the calibration of the instruments in circuit with the small motor. These instruments must be fairly sensitive, but since their object is only to insure that the input shall be the same in the first as in the second run, the accuracy of their calibration is of no importance.

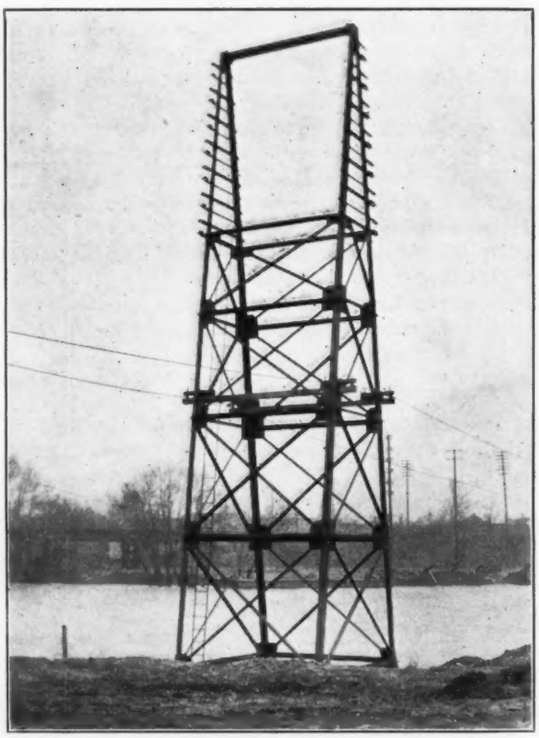
Pittsburgh, Pa. F. M. Denton.

RIVER-CROSSING WIRE TOWER.

An interesting piece of engineering made by the Indiana & Michigan Telephone Company at a point in South Bend, where the lines cross the St. Joseph River, is shown herewith. Two steel towers, about 100 ft. high, are placed upon opposite banks of the river, apparently about 600 ft. apart. A heavy concrete foundation, in the river bed, has been placed under each tower and the foundations are in the form of a monolithic rectangle enclosing a mass of earth, which was placed inside. Apparently the foundations, which are 18 ft. x 22 ft., are about 2 ft. thick above the water line, and of greater thickness at a distance below the surface of the river. The depth of the foundation is not known to the writer, but from the location and the character of the surrounding and adjoining earth formation, a depth of at least 15 ft. is to be expected. Heavy anchor bolts attach the steelwork to the concrete foundation, and without seeing the plans or making any calculations, it seems to the writer that the tower was designed with sufficient resistance to strain and transverse pull to be able to stand up under the load of horizontal wire-pull should each wire and cable be cut on the land side of either tower. To this end, the sides of the tower which are parallel with the wire and cable lines are vertical; the sides parallel with the river incline toward each other, but the river side of each tower inclines as much, or more, than the land side.

The towers up to the wire racks are framed in four panels, each panel being double braced, diagonally, and double plates are riveted on at each panel intersection. This gives each panel its own separate horizontal girt, top and bottom, and to secure stiffness the top girt of each panel is riveted to the bottom girt of the panel above it—all except the upper girt of the top panel and lower girt of bottom panel, which are necessarily single. The tower is very fully braced, ample plates being provided for the secure attachment of the braces to the posts and to the girts. A steel ladder is attached to and built into the tower as shown, and the space above the top bent of plates may be floored over, if desired, to form a convenient landing place from the ladder and for ease of access to the wire supports, which may be placed upon the upper A-gables of the tower.

At this writing the tower is carrying only one cable—or rather two branches of a single cable, which is plainly visible in the engraving just above the top of the second brace panel. That this tower was designed for single wires can be readily determined by the presence of the 14 angles already in place upon the A-ends of the tower, upon which cross-arms may be attached for the support of the regulation insulator. But it is evident that the development of the cable has materially changed the method of carrying many lines of telephone wires and that instead of many single wires the multiplex cable will be used, as a start has been made in that direction by the installation of the cable already in place. As nearly as the writer can determine, this tower was erected about two years ago,



Wire Tower at South Bend, Ind.

and just as the panic hit the country so hard that extensions and improvements were all dropped whenever possible. The development of the aerial cable, together with the fact that South Bend is having its wires put underground, will probably lead to the abandonment of the multiplicity of cross-arms which this tower was originally planned to accommodate. But many cables can be carried by this structure, and with an abundant margin of strength and capacity.

The cables are not fastened to the tower by means of insulators, but are carried straightway between the supports, which consist of 6-in. x 6-in. timbers bolted to the sides of the tower. The catenary of the cable is regulated by a turnbuckle, which is tied fast to the tower upon the landward corner post. The other end of the turnbuckle is attached to the cable by means of a lashing, and the whole is placed between the two timber supports of the cable, which, as may be seen in the illustration, are attached to the shore and river sides of the tower, respectively. A ½-in. steel-wire rope is attached to each tower, one panel above the regular cable supports. This wire rope does not show in the engraving. At two equidistant points be-

tween the towers on either side of the river the telephone cable is attached to the wire rope by means of two short steel connections. Thus the telephone cable is supported in two places in addition to the tower supports. This makes about 200 ft. between supports. The wire rope which does the supporting is also adjustable by means of a turnbuckle.

South Bend, Ind. JAMES HOBART.

TROUBLE WITH LAMP CORD.

Readers might be interested in what is left of a drop cord, which came very near causing a serious fire. One leg of the cord became broken near the socket, causing an arc which set fire to the cord. This burned to the rosette and set fire to the ceiling. By that time the rubber insulation was burned through, causing a short-circuit which melted the remaining leg of the

Remnants of Drop Lamp Outfit.

circuit and allowed the socket and lamp to drop to the floor. The noise made by the socket in dropping and the implosion of the lamp attracted the attention of the family who were in another part of the house, whence the fire was detected and extinguished.

Chatham, N. J. IVAN M. K. SMITH.

NEAR-SIGHTED ELECTRICAL CONTRACTING

According to the writer's experience, a great many electrical contractors endeavor to underbid each other in securing a contract for wiring, and as a rule they will bid so low that it is a physical impossibility for them to do a first-class job and furnish first-class material at the prices for which they contracted to do the work. One cannot get something for nothing, and in this case the material on a contract job of this kind is of a poorer grade, although it may pass the average inspection. In fact, it is so close to the margin, or to the edge of rejection, that in common language, one cannot stick a piece of tissue paper between the margin and the safe side without its losing its balance and toppling on to the rejection. The result of all of this comes back to the consumer of electricity or the owner of the plant in which this wiring is done. He has to have all of this work done over again at an additional expenditure of money, which he could have saved himself had he stopped to think for one moment and not try to see how cheaply he could get the work done; or had the contractor been conscientious and impressed upon the mind of this consumer the necessity of first-class material as well as labor and shown what would happen under certain conditions, instead of merely trying to sell him a bill of goods and throwing them on his walls and ceilings.

The average consumer or householder will go to a contractor and say: "I want a dozen or more lamps installed; how much will you do it for?" The contractor will figure only on a dozen or more lamps, naturally, and, as usual, never ask: "Is there a possibility of there being more required at some future period?" He gets the contract to wire the house for a ridiculously low sum. He will use the cheapest grade of No. 14 wire for his circuits, load that up with as many lamps as the circuit will stand, get an inspection certificate from the city inspector, turn the job over to the consumer and get his money. The city inspector will, as a rule, come around, tear off the taping of a few joints, stick his finger in several sockets, hem and haw a few times and look wise and pull out his little notebook, jot down a few figures and go off and issue his certificate of inspection and never see the job again until the place is either burned down or an additional number of lamps has been installed.

Meanwhile the consumer goes downtown, sees a nice flat-iron which he would like to bring home to his wife; buys it; takes it home and connects it to the lamp circuit. A few weeks later there is a sale of curling irons at one of the department stores. He buys one and takes it home also and connects it to the lamp circuit. Next day a friend of his shows him a toaster or a coffee percolator or a baby's bottle heater and as likely as not he will buy them, take them home and also add them to the circuit. At the same time his wife has been visiting neighbors and she sees the loveliest washing-machine and wringer attachment which she must also have. This must also be connected to the lighting circuit. About this time the summer has fairly gotten in its work. Mr. Consumer arrives home, warm and thirsty, and will start a fan or two to keep him cool. His servant in the kitchen will have a small motor running the ice-cream freezer; his wife in a little cozy corner will have a chafing-dash going full blast—all of these on the same lamp circuit, which was originally intended for a dozen or more lamps.

Has it ever occurred to the average city electrician how many additional electrical appliances are being promiscuously thrust upon a poor overworked lamp circuit? Has it ever occurred to warn householders of the risk they are taking in connecting all these appliances on a pair of No. 14 wires? Has the contractor ever tried to bring this matter to the attention of the other city electricians so that a concerted action could be taken up, so as to regulate the use of household attachments or to educate the consumer to the point where he will use these different appliances, but with a comprehension as to the carrying capacity of this lighting circuit? Of course, the average contractor doesn't care how much Mr. Consumer adds to the circuits after he gets away from the building; and the company that furnishes the energy doesn't care how much energy Mr. Consumer uses as long as he pays for it. It would seem to the writer that with all of this engineering talent someone would stop to think and figure all these little odds and ends and bring them to the attention of the various engineering firms, architects or consulting engineers.

Council Bluffs, Ia. FRANK J. SMITH.

THE CHOICE OF ELECTRIC SIGNS.

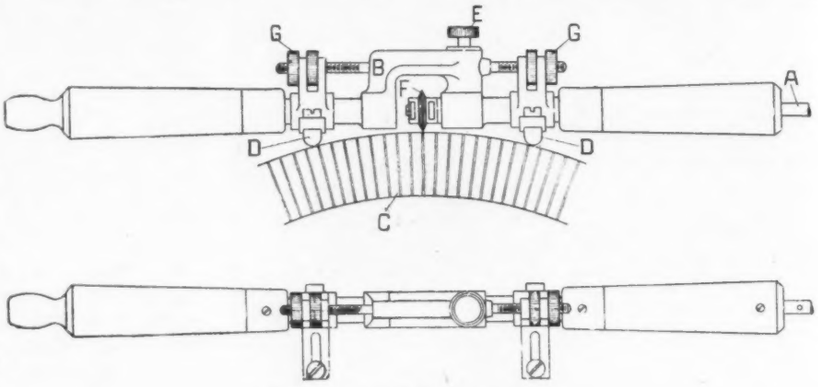
Probably no business that the central station is engaged in at the present time has shown a more rapid percentage of growth during the past few years than that of electric signs and the supplying of energy for lighting these. In spite of the great increase in the number of signs in use, there still exists in the minds of many central-station men the question whether or not the sign is a paying investment. In the past, many central-station managers have not given this part of their business the attention that it was entitled to, and in many cases have installed signs unsuitable to perform the work intended. Such instances may be sighted in nearly every city. In many cases the lamps of signs which should be illuminated all night are not cut into circuit even for a short period in the evening because the cost of operation is excessive. When a merchant installs a sign, he is entitled to the best service at the lowest possible cost. If he finds it is necessary to pay either an ex-

cessive amount for the energy consumed by a sign or else have no sign, he will invariably refuse to make the installation. With the view toward reducing the expense of operation, a number of signs have been devised whereby a few lamps will furnish the light units which formerly required a large number of lamps. These are particularly desirable for use where all-night service is required. In many instances noted excessive rates for energy have been charged and in some cases attempts have been made to interfere with the installation of signs requiring only a few lamps, as it was figured they would not use the amount of energy the central-station manager thought desirable. This attitude has occasionally resulted in the sign manufacturers refusing to co-operate with the central-station men, and in many cases the manufacturers have proceeded to make installations without ascertaining the wishes of the company. Co-operation between manufacturer and the dealer is as necessary in this branch of the electrical business as in any other, and until this co-operation shall be secured, no large increase in this business can be hoped for. The chief remedy lies with the central-station manager, who should deal with the matter in a liberal way. He should study the conditions to be met in each installation and recommend the best installation to suit the conditions. Sometimes the small storekeeper cannot afford to operate a large all-lamp sign, but he can afford to operate a sign of the same size provided it can be satisfactorily illuminated by a few lamps. The central-station manager in justice to himself and his customers should not insist that the all-lamp sign be installed in every case, as this attitude inevitably results in a feeling of hostility when the expense of operation is fully realized and in many cases results in the sign being temporarily or permanently abandoned so far as illumination is concerned. There is a limit to the number of kw-hours or to the expense which a certain business can stand for electric signs, and that sign is most practical which best meets the needs and purse of the user.

Chicago, Ill. Frank W. Collard.

GROOVED COMMUTATORS.

Electric railways have found it advantageous to slot the commutators of motors, since by this means sparking brought about by high mica or improper contact is almost eliminated and about one-half of the troubles experienced in railway practice are done away with. The writer was for a time in charge of a plant in which there were a number of motors fed with energy from the local central station. The motor circuits of this company have a potential of 500 volts; a tension still in vogue in a number of places, but now fast disappearing. The motors were very well loaded, in fact in some cases were operating overloaded, and it was found that some of the commutators required sandpapering very frequently, while others did not. The crane motors especially were always a source of trouble and worry, and for a time it was felt that this condition could not be obviated. The motors were handled none too delicately, and not being easy to get at did not receive the attention they should; hence, the commutator troubles were expected as a matter of course. When, however, flash-overs became quite frequent and the cranes had to be shut down at times, an investigation was ordered to see if matters could not be remedied. It was found that not only was the mica in the commutator of the crane motors very hard, but to make matters worse a soft brush was substituted because of its better conducting qualities in the hope of mitigating the commutator troubles that existed. In other words, the fault was laid to the brushes and not to the mica. The other motors around the shops were fitted with harder brushes possessing the cutting qualities necessary to keep down the mica so that trouble from them never was serious. About this time the writer read of a master mechanic grooving or slotting commutators on railway motors to overcome the nuisance of sparking, and the conditions being somewhat identical applied the same remedy. First, a triangular file was used in making the groove, then a scraper, and finally a lathe fitted with a small motor-driven milling cutter was pressed into service. To be sure, good work was not done at first. The copper was burred and some of it buried itself in the mica, we afterward discovered, so that ever after care was taken to rub down the burrs, sandpaper the commutator and clean out the grooves well. At any rate, commutator troubles were reduced enormously and by substituting a brush that worked best with a slotted commutator and blowing



Commutator Grooving Machine.

out the accumulations in the slots from time to time shutdowns from flash-overs, etc., were exceptional. It was then found desirable to obtain some other means of slotting the commutators, since a lathe could not always be spared and the little motor which was attached to the lathe and drove the slotting device was required for another purpose. There was at that time, so far as the writer could find, no device on the American market built for the purpose of slotting or grooving commutators, and it was only accidentally that a foreign device was procured; the company having expected to have one built specially for the purpose. However, the foreign article seemed so much better than any we could devise that an order for one was given. The device is shown diagrammatically in the illustration herewith. There is a bronze body manipulated by two handles and in a recess in the body or frame is mounted a milling cutter *F* driven through a shaft *A*. The apparatus is portable and rests on the commutator, feet *D* being provided so that the relative position of the surface of the commutator and the milling cutter may be adjusted by means of the thumbscrews *G*. Very accurate adjustment of the milling cutter with reference to the depth of the cut is possible and in order to adapt the device to commutators over a wide range of diameters, feet of different heights are supplied. The sizes range from 4 mm for diameters from 900 mm to 1200 mm up to 19 mm for diameters from 100 mm to 160 mm. A ⅛-hp motor drives the milling cutter at a speed of about 700 r.p.m. through a telescopic shaft equipped with universal joints at each end. The handle opposite the one through which the driving shaft is inserted carries a tube connected to a suction line through which the dust or chips as they are thrown off by the cutter are removed. This device is very easy to operate and does good work. The armatures were removed and placed on a commutator truck or stand of the usual design. The operator sat at one end of the truck or stand and guided the machine back and forth. We found it advisable to slot the commutator from 1/16 in. to 1/8 in. deep and the width of the slot was equal to that of the mica. After sandpapering the commutator and inspecting the slots for metal chips, it was ready for work again. It was finally deemed best to employ carborundum paper for getting rid of the burrs and for polishing the commutator. An advantage possessed by a slotted commutator is that a softer or self-lubricating brush with excellent conducting qualities can be employed which also gives a better contact between the brush and the commutator.

Buffalo, N. Y. John Howe.

QUESTIONS AND ANSWERS

Is there any set rule for determining the amount of contact surface ordinary carbon brushes should have in direct-current motor practice? G. G.

Ordinarily the contact surface of regular carbon brushes should not be less than $0.9\ I \div \sqrt{V}$ sq. in.; where I is the current in amperes and V the peripheral velocity of the commutator in feet per minute.

How can the ratio of series transformers used in connection with switchboard instruments be best checked? P. I. Y.

It has been recommended that series transformers be tested when first received and a record made of the actual ratio curve throughout their range from light to full load. This information should be obtained by two tests upon the meter, one with and one without the transformer under both inductive and non-inductive loads.

Why are not steam turbines used in the high-class apartment houses in large cities, where economy of space should be of vital importance and where this particular feature of the steam turbine should suggest its use? E. T. R.

The steam turbine has not been able to displace the slow-running Corliss engine in large apartment houses in New York City at least, because of its noisy operation. Where steam turbines have been tried the hum set up has been objected to by the tenants. The slow-speed Corliss engine is very quiet in action.

Do not fuses and circuit-breakers possess the same characteristics?

They do in a limited sense, in that both operate to open the circuit on overload. The characteristics on the whole, however, are very dissimilar. A circuit-breaker depends for its operation on the quantity of current; a fuse, on the quantity of current and the time during which it is applied. A circuit-breaker opens immediately on any overload in excess of its setting and will not operate on any smaller current, no matter how long the current passes. A fuse possesses a time element, and the greater the overload the quicker its action.

Are Edison tubes used to any extent at the present time? What are the reasons for their gradual disuse? H. J. T.

Most of the Edison companies are replacing the so-called Edison tubes with vitrified conduit and cable, and no new Edison tubes are being installed. One of the reasons for the change is the high cost of street openings necessitated by replacements; another reason is that many municipalities prohibit the installation of any other than a drawing-in type of underground conduit system, so as to minimize the tearing up of streets and the interference with traffic when repairs are required.

Does a shell-type, three-phase transformer possess any advantages not possessed by a core-type transformer? C. F.

The shell-type three-phase transformer has the same reserve capacity as three single-phase transformers when connected delta-to-delta, since substantially two-thirds of the energy can be transmitted by two of the cores when the third phase has been damaged and short-circuited. In that case the winding of the damaged phase is short-circuited upon itself and disconnected from the other. The core type transformer has not this advantage; but enables the use of a star-to-star connection, at least for moderate voltage.

Kindly give a method for calculating the reactance of an induction coil. G. M.

The reactance of an induction coil expressed in ohms is $X = 6.28 fL$, where f is the frequency in cycles per second and L is the coefficient of self-induction in henrys. There is no simple formula for determining the value of L; but it is said that fair results are obtained with the formula $L = (3.14\, d\, n)^2 l \div 1{,}000{,}000{,}000$ where l is the length of the coil, d its diameter in centimeters and n the number of turns per centimeter. This formula is applicable only when the length is not greatly different from the diameter.

A shunt-wound motor heated excessively, sparked at the brushes and although the circuit-breaker was set at 70 amp., the motor being rated at 45 amp., it opened continuously making operation impossible. The speed remained normal and the only fault found was a bad contact between the negative cable and the main terminal on the machine due to a loose terminal nut. One end of the shunt circuit as well as the negative brush lead was connected to the terminal, and when the nut was tightened, the trouble disappeared entirely. We have been at a loss to account for the behavior of the motor and would be pleased to have your opinion on the matter. N. O.

At first sight it would appear odd that a resistance in the main circuit of the motor should increase the current taken and not affect the speed. However, while the voltage across the armature is reduced, tending to reduce the speed, the shunt current is also reduced in the same proportion, weakening the field and tending to increase the speed. Evidently these two effects nullified each other so that the speed remained normal. In order to carry its load under reduced voltage, the motor of necessity drew an excessive current, hence the opening of the circuit-breaker notwithstanding its high setting.

Is a motor-converter a synchronous-converter or a motor-generator? What are its characteristics and wherein does it differ from either of these machines? C. T.

The motor-converter consists of an induction motor mounted on a common base and direct connected both electrically and mechanically to a direct-current machine. The rotor of the induction motor is polar wound and connected at suitable points to the armature winding of the direct-current generator. This construction permits equal parts of the energy received by the motor to be transferred to the direct-current generator through its windings electrically as in a synchronous-converter, and through its shaft mechanically as in a standard motor-generator set. Its efficiency is lower than that of a synchronous-converter. The motor-converter is used chiefly in Europe, where it is preferred to the synchronous-converter and the motor-generator. It is somewhat less expensive at high frequencies than the synchronous-converter. We know of no unit in operation in this country.

In a system generating at a pressure of 2300 volts and stepping up to 26,400 volts there is a motor-generator set which operates between the step-up transformers and the 2300-volt generators. There are three switches used to transfer the motor-generator set from one generator to another, and these change-over switches were so connected that it was impossible to parallel the generators on the 2300-volt side. In redesigning this switching arrangement it is planned to install four switches instead of three, so that the motor-generator set can be fed from four generators. The switches used heretofore were three-pole, double-throw, and it is purposed to install four three-pole, single-throw switches in their stead. What will be the result if two single-throw switches are put on the 2300-volt bus at one time or if the generators are paralleled on the 2300-volt side? H. C. P.

The information given is not sufficient to serve as a basis for a definite answer. However, it is probable that you have in mind the possibility of switches connected to the motor-generator set being thrown simultaneously upon the circuits of two separate generators, thereby placing the two machines in parallel. The conditions assumed are those found when generators are paralleled through the common system of busbars. As you are doubtless well aware, no difficulty is experienced in paralleling alternating-current generators when instruments are available for determining the relative phases of the electromotive forces of the two machines. However, damage is sure to occur at some time if the switches are closed without any knowledge as to the instantaneous phase positions of the two generators. In the present case the machine should either be supplied with indicating devices for showing when the two machines are in the proper position for paralleling, or the switches should be so arranged as to render it impossible to place any two of the machines in parallel.

Central Station

Management, Policies and Commercial Methods

A LIVE PLANT IN A SMALL TOWN.

The central station of Williams, Ia., a town of about 600 population, is owned by the F. R. Payne Company. Seventy-two out of 103 residences in the town are wired and each of the 72 residence customers has a flatiron. Day service is given. The plant is run in connection with a flour mill. There are 32 motors connected, the largest being 20 hp. The system is 220 volts direct current. This is a notable record for a small town.

ELECTRIC HEAT IN LAUNDRY CHEAPER THAN GASOLINE.

One of the most complete electrically operated laundries is that installed at Sikeston, Mo., where the rolls, irons and all the washing machinery is heated or driven by electricity. There is no gas in Sikeston, reports the local central-station operator, Mr. C. L. Clary, and the electrical equipment of the laundry was decided upon as being cheaper than gasoline-heated apparatus, besides having obvious advantages of cleanliness, simplicity and safety. The actual operation of the laundry has since borne out this position taken by those who put in the electrical equipment.

GALVA (ILL.) MUNICIPAL LIGHTING.

At a meeting of the Galva (Ill.) Commercial Club, April 21, various municipal problems were discussed during a "Swede lunch," the chief topic being the introduction of electric power in Galva. This involves the sale of the municipal lighting plant, and Mr. Glenn Marston, of New York, gave an address on the advisability of securing adequate electric power for industrial purposes.

Following Mr. Marston's talk, a resolution was presented calling for an investigation by the Council of the best way of disposing of the municipal street-lighting plant. The resolution was adopted by a unanimous vote of the 400 members present, the ballot being followed by loud and enthusiastic cheers.

Mr. Marston said that public improvements and public utilities mark the progressiveness of any city. No community can succeed without the best of both. Since it was Galva's purpose to attract new industries, she must have an adequate power supply. The Commercial Club's records showed that 95 per cent of the prospective industrial concerns making inquiries asked if they could get electric power. "The club has done much for the city," he said, "but it is up against a stone wall now, and it is up to the people of Galva to give them a free hand to make the city attractive to new industries. Electric power means more industries, better pay, shorter hours and more money in circulation." It is proposed to use the money obtained from selling the municipal plant for much-needed paving and sewers.

DUBUQUE (IA.) STATION WITHSTANDS HOT FIRE.

The steam-turbine electric generating plant of the Union Electric Company, Dubuque, Ia., which supplies power for railway and lighting purposes, had a severe test recently which, in the language of one of the local newspapers, demonstrated that it was fireproof in fact as well as in name. This station is located on the banks of the Mississippi River in the midst of a lumber district. There was a severe fire in the lumber surrounding the plant, the wind being in a direction to sweep the fire against the boiler-room side of the plant. The heat was so intense that the windows soon broke, and even those with wire-glass were hot enough to collapse, allowing considerable heat and smoke to enter the station. The fire-fighting, as far as this station was concerned, was all done by Union Electric Company men under direction of Mr. F. D. Mathes, general manager, as the city fire department was busy keeping the flames from spreading to other parts of the lumber district. The plant has a large steel-plate stack and the heat was so great that one side of this stack was red hot and the expansion on the heated side threw the stack temporarily far out of plumb. In fact, it was much feared that the stack would tip over. After the fire, however, it settled back to a nearly plumb position. On the whole, the station pulled through the fire with very slight damage. The test was as severe as could well be devised, as burning lumber piles make a fire hotter than is often encountered in built-up sections of a city.

LIFE OF TUNGSTEN STREET LAMPS AT CEDAR FALLS, IA.

At the Iowa Electrical Association convention, at Sioux City, April 20, Mr. J. P. Jones, of the Citizens' Gas & Electric Company, of Waterloo and Cedar Falls, gave some figures on the life of series-tungsten street lamps in service at Cedar Falls. This covered the performance of tungsten lamps of 32 cp and 40 cp burning on series circuits of 6.6 amp and 3 amp. The first of these lamps were put in service July 11, 1908, but the early lamps were much less durable than those which have been put in during the last year. The period covered by the figures is from July 11, 1908, to April 1, 1910.

Of the lamps which have been burned out in service the average life was 843 hours. The total number of lamps burned out in service was 282. Of these 40.2 per cent burned less than 500 hours, 21.6 per cent burned from 500 to 1000 hours, 25.6 per cent burned from 1000 to 2000 hours, 11.1 per cent burned from 2000 to 3000 hours, and 1.5 per cent burned over 3000 hours.

Of the lamps in service April 1, of which there were 223, the average hours' burning per lamp was 991. Of these, 14.8 per cent had not yet burned 500 hours; 19.3 per cent had burned from 500 to 1000 hours; 23.3 per cent had burned from 1000 to 2000 hours; 30 per cent had burned from 2000 to 3000 hours and 12.6 per cent had burned over 3000 hours. From this it is seen what a marked improvement has been made in the lamps since this service was begun. The final average of these lamps still burning will, of course, be much higher than it is at present.

In discussion of these figures, Mr. A. L. Dodd, of Charles City, reported results with some series-tungsten lamps which have burned over 2000 hours in service. Mr. W. A. Mall, of Belle Plaine, reported having 110 multiple 110-volt lamps of the 100-watt size in such service. These burned 2700 hours per year, and he has had 184 renewals in one year or less than two renewals per lamp per year.

DEVELOPMENT IN OIL ENGINES.

Mr. E. D. Meier read a paper at the Boston meeting of the National Association of Cotton Manufacturers, April 27 and 28, entitled "Progress of the Diesel Engine," in which were outlined the results now obtainable with this type of prime mover. The author said that a speed regulation of within 2 per cent of normal on each side of the average is guaranteed by the

American builders. The early economy has been improved by an increase in thermal efficiency and refinements in mechanical construction. Modern Diesel engines exceed 30 per cent in thermal efficiency. The conservative guarantee adopted some years ago, that the consumption of fuel oil per 100 hp-hours of net work shall not exceed 8 gal., or 0.568 lb., per hp-hour, has been easily maintained and is now extended to cover running at any load between half rating and full value. This guarantee leaves a large margin to cover inferiority in fuel, lubrication and operation by the plant attendance.

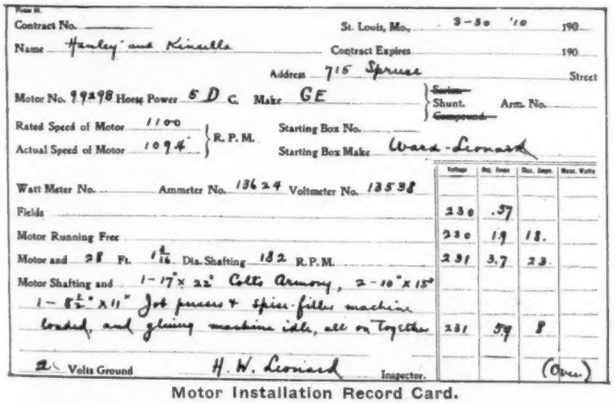
Assuming a consumption of 6.25 gal. of oil per 100 hp-hours and an average price of 3 cents per gallon, the author stated that to obtain the same result from a non-condensing steam engine coal must be bought at 39 cents per ton delivered on the grate; while with a good condensing engine the competitive price would be 62 cents per ton. The competitive prices for natural gas would be 19 cents per 1000 cu. ft., and for illuminating gas, 12 cents. If the consumer uses producer gas he cannot pay over $2.10 per ton for hard coal, or 72 cents per ton for soft coal, and the author contends that he cannot afford to pay over $9.75 per hp-year, nor more than 0.5 cent per kw-hour for electricity.

The author claimed that the repair account of the Diesel engine is moderate, the average for 21 engines of the 200-hp size being 13 cents per hp-year. There are installed in the United States 162 Diesel engines aggregating 30,240 hp; of these 10,060 hp represent repeat orders, and 3010 hp are in textile service.

MOTOR INSTALLATION RECORDS.

In the case of trouble with motor installation it is often of considerable service to the repair man to have a record of the characteristics of the layout when in proper working order, as well as some office information on the apparatus itself, so that proper preparations can be made or a similar machine sent out for replacement without loss of time.

The Union Electric Light & Power Company, of St. Louis, makes a practice of doing emergency and general repairs on customers' motors and special appliances, for which purpose it maintains men and facilities for promptly undertaking almost any sort of electrical repairs. It also has a free motor inspection department, by which all such installations on its service are examined regularly by experienced inspectors, who leave copies of their written reports with the customers, also taking records of the condition of the installations for office


Form H.
Contract No. _____ St. Louis, Mo., 3-30 '10 190
Name Hanley and Kinealy Contract Expires 190
Address 715 Spruce Street
Motor No. 99298 Horse Power 5 D C. Make GE Series Shunt. Compound. Arm. No.
Rated Speed of Motor 1100 R. P. M.
Actual Speed of Motor 1094
Starting Box No.
Starting Box Make Ward-Leonard
Watt Meter No. Ammeter No. 13624 Voltmeter No. 13538

	Volts	Am. Amps	Rec. Amps	Rec. Watts
Fields	230	.37		
Motor Running Free	230	19	18.	
Motor and 28 Ft. 1 1/16 Dia. Shafting 182 R.P.M.	231	3.7	23.	
Motor Shafting and 1-17"x22" Colt Armory, 2-10"x18" 1-8½"x11" Jot presses + spice filler machine loaded and gluing machine idle, all on together	231	59	8	

2 Volts Ground H. W. Leonard Inspector. (Open.)

Motor Installation Record Card.

file. All motor installations are tested shortly after being put into service, and records of these results are kept on filing cards in the company's office, arranged according to street number The card used shows the name plate data of the motor and starting box, and gives a brief description of the machines driven, together with the current taken by the motor under various conditions of load. The accompanying reproduction of such a test card relates to a 5-hp direct-current motor installed in the boxing department of a large wholesale grocery concern. This motor drives several printing presses, a box-filling machine and a gluing machine. The back of the card is available for a detailed record of the readings, from which the average values given were made. Nearly all the motors installed on its lines in the city are listed in this card-record system, and the scheme has proven of special service for comparison in case the energy consumption of the customer's motor later increases due to faulty drive or other reason.

PUSHING HEATING-APPLIANCE SALES BY LOANS TO SOCIAL GATHERINGS.

The North Shore Electric Company supplies electric service to the suburban territory surrounding Chicago. Included in this area are a number of high-grade residential districts, where most of the homes are those of people whose comfortable circumstances make them potential users of electric heating devices. A satisfactory and successful way of bringing these appliances to the attention of probable purchasers, which has been employed by this company, is the loan of percolators, toasters, stoves, etc., to neighborhood, club and private social gatherings. Solicitors for the company keep a careful lookout for all affairs where the use of such appliances would be appropriate, and shortly before the date of the gathering, the proper person is approached and offered the loan of the device for the occasion. No obligation is incurred on either side, and the use of the loaned appliance is not accompanied by any advertising which might prove distasteful to the hostess. Those present are simply given a demonstration of the convenience and simplicity of cooking by electricity, and all inquiries are referred to the local showroom. In the case of large gatherings, the company sometimes sends an attendant along with the device, and in some instances furnishes coffee, toast or other edibles prepared by electric heat. Many sales of electric heating appliances are traceable directly to these exhibitions, and the plan has been attended by such success that the North Shore Electric Company now has several special solicitors devoting their time to securing this class of introduction. All resulting sales are made outright in the showroom or by the solicitor, although in the case of vacuum cleaners, washing machines and sewing-machine motors, where the purchase price exceeds $25, the customer is allowed to pay the amount in 12 monthly installments.

The loan of electric cooking devices to social gatherings is not new with the North Shore Electric Company, as a number of other central stations have employed the same scheme, sporadically or on a smaller scale, but the results secured in the case cited are significant of what can be done by proper solicitation in almost any residential section of the better class.

PROFITABLE RESALE OF TRANSMITTED ENERGY IN SMALL TOWNS.

The small central station stands at the disadvantage that 24-hour service is out of the question, however much a few of its customers may desire all-day electricity for motors and lamps. The matter of transmission has in some cases solved this and the other troubles of the small central-station operator, when his town or consumers are within striking distance of a larger place where all-day service is the rule. Indeed, as in the present example related by Mr. M. H. Ledford, of Bowling Green, Mo., before the Missouri public-utility operators' convention at Jefferson City, April 15, it is sometimes to the advantage of the small place to abandon its local generating station, and to install a transmission line from the plant of its larger neighbor, where a fair rate for such service can be made with the generating company, leaving a good profit for the transmitting and distributing company.

Bowling Green, Mo., had a 30-kw steam plant which was

erected in 1891 and finally reached the end of its serviceability in 1905. Instead of rebuilding a generating station, the desirability of 24-hour service and other considerations of simplified operation, led to the formation of a $20,000 company which erected an 11,000-volt, single-phase transmission line to Louisiana, Mo., 11 miles distant. The transmitting company thus purchases energy at the generating-station buses, supplying its own transformers for raising to the transmission voltage which is again reduced at the Bowling Green destination. In 1909 the transmission company purchased 64,320 kw-hours at the Louisiana bus, for which it paid 2½ cents per kw-hour. After a loss of 21,440 kw-hours in transmission, distribution and unaccounted for, it delivered 42,880 kw-hours to its 180 customers. The company has a 17-year franchise for selling electricity at 20 cents per kw-hour, with a minimum charge of $1, but offers an optionary rate of $1 per month service charge, plus $3 per kw of maximum demand plus 5 cents per kw-hour. Thus it received $7,164 as its gross income, having paid $1,608 for this energy together with that lost in transmission. The average rate received for its retailed energy is about 16 cents per kw-hour. The total connected lighting load at Bowling Green is 100 kw, and in motors 30 kw. The peak lighting load is 37 kw, and for motors 30 kw. The lowest rate obtained by any consumer is the local water works, on account of its comparatively large load factor of 19 per cent. For 3272 kw-hours, with a maximum demand of 2 kw, this plant pays 7.5 cents per kw-hour. Another large customer, having a 5-kw connected load and a load factor of 9 per cent, paid $743.80 for 3719 kw-hours at 20 cents. On the other hand, the local opera house, as is typical of smaller towns, consumed only 359 kw-hours with its 5-kw connected load, a load factor of 0.9 per cent, for which it paid $71.80 at 20 cents per kw-hour. One man looks after the maintenance and repairs of the line and distribution system and makes all new connections.

CENTRAL STATION RATE-MAKING.

At a recent hearing given by the Massachusetts Gas & Electric Light Commission at North Adams, Mr. Arthur E. Childs presented a discussion of central-station rate-making in defense of the general policy of the North Adams Gas Light Company. The speaker reviewed briefly the necessity for imposing a minimum charge for the use of a gas or electric meter. He stated that at the present stage of the art a charge of $1 per month for electricity per meter installed seems to meet the situation.

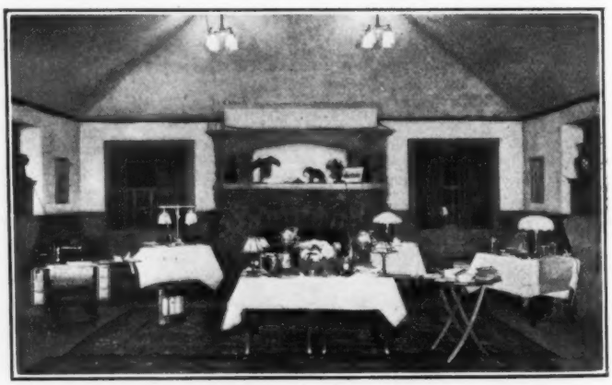
The two principles upon which to build the rate-making power are: First, the company is granted certain privileges by the public for the purpose of enabling it to furnish readily some type of service to the people, and it should be expected to furnish service fitting the needs of the people, good of its kind, and at prices which are reasonable, judged by the conditions; second, the company must not be unnecessarily harassed, but must be afforded every reasonable opportunity for conducting its business economically in relation to giving the service for which the company was organized, and it must be allowed to make such clear profits over all legitimate costs of its service that it will attract the best and fairest minds to the management and maintain a position of stable credit with the investing public. In order that the service rendered by a business corporation occupying a special grant from the public may be all that it should be in details of operation and in its adaptation to the changing needs of the public as public conditions change, it is of the utmost importance that the operations of the company shall be managed by high-minded, broad-gage men of foresight and comprehensive grasp of commercial affairs. Such men are ordinarily not attracted to and cannot be retained in the service of companies which are hampered and annoyed in trivial matters, or are put under the pressure of harsh conditions which prevent earning sufficient profits to pay interest on the investors' money actually put into the property, such as the larger merchants and business men would hold to be reasonable.

Interest on the investment has a much larger influence on the rates of a public-service corporation than ordinary mercantile experience might lead one to believe. Merchants, bankers and other business men expect to turn over their capital every year, and it is not unusual in mercantile affairs to turn it over several times during a year. This condition reduces the proportion with which the interest on the investment enters the prices which must be charged to customers, because the interest is spread over sales aggregating from one to many times the capital. In most manufacturing businesses it is common to turn out annual product of greater value than the capital invested. On the other hand, most public-service corporations are situated under contrary conditions. Instead of making a gross annual income equal to or exceeding the capital investment, an electric light company ordinarily must expend a sum in establishing its plant and business which is not less than three times the annual gross income which it may expect to receive, and which may often be six times the income. This relation at once multiplies the influence which interest on capital exerts when charges for service are to be determined, which is exactly the contrary of the conditions which obtain in most branches of general business. A public-service corporation cannot do business on the usual margin of general manufacturing profit and live; a larger proportion of its gross annual income must be available for meeting the demands of interest or the project will fail.

APPLIANCE EXHIBIT IN RESIDENTIAL SECTION.

By William H. Stuart.

For some time past the new-business department of the Public Service Corporation of New Jersey has been at a loss to know just how it could get the people, especially the women, who lived in high-class residential sections interested enough in the various electrical appliances to care to witness a demonstration. The company felt that for these people to see, feel and taste the work and the products of the appliances would be worth much more as a selling force than any other method. The way was opened when the company recently gave a very successful exhibit, demonstration and lecture on household appliances at the Commonwealth Club, in Montclair, N. J.



Appliance Exhibit in Montclair.

Some time ago Mr. R. R. Young, division agent, who is in direct charge of the new-business work of the electrical department covering this territory, made arrangements with some of the representative women connected with the various women's clubs in Montclair to give this exhibit. Permission was obtained to hold the affair at one of the exclusive clubs, the Commonwealth Club, one afternoon and evening, from 3 p. m. to 9 p. m. The company was furnished with a selected list of 2000 names of well-to-do people in Montclair. An engraved card was sent out to each person on this list extending a cordial invitation to call and witness the exhibit. On a table at the entrance to the reception hall was placed a number of booklets entitled "Electricity in the Home." This

booklet showed 10 colored "pretty girl" views of the various appliances in actual use, with a short, brief statement under the views of the capabilities of the device and the cost of operation. Under the view of the girl using an electric chafing dish, for instance, appeared, "Will make creamed oysters, omelets or welsh rabbit for 2 cents." A young lady was stationed at this table who secured the name and address of each guest as she handed out the booklets.

The exhibit proper was located in two very large rooms on the main floor, and here the appliances were shown in actual use. In one corner creamed chicken was served direct from the electric chafing dishes. A little further off fudge was made. Across the way coffee and crullers were given to those who desired them. The sewing machine, curling and flatirons, toasters, heating pads, etc., were all shown to good advantage. Interest was aroused in the way the appliances performed their work. Orders were taken for the direct sale of the appliances, for a 30-day trial or for a future private demonstration. One appliance that attracted considerable attention was the vacuum cleaner and its work. A few cleaners were sold outright and a considerable number were ordered on trial. Just off the exhibit space in a small hall a number of short talks were given on the use of the various devices by the head of the appliance department covering this territory.

Mr. Young, in speaking of this exhibit, said: "We have gained considerable from this exhibit in the Montclair territory. Our customers approached by a straight canvass, and when we received the opportunity to secure their attention so that we could demonstrate the various appliances, we felt sure that we could sell and introduce a great many. We were gratified by the way the invitations were responded to. The list, as furnished to us, we will keep and use for a series of follow-up letters and for other mailing purposes, also the same with the names secured by the young lady at the entrance to the club. This is our second appliance exhibit along these lines, and as both seemed to be successful in getting us new business we will arrange to give more of them in other towns and cities throughout the system. In the Newark division we have a well-organized appliance department and we are opening up in the other territories throughout the State similar departments. The business will be pushed energetically and we expect good results."

METERS AND CONSUMERS' COMPLAINTS.

Mr. Adrian Tobias, of LaFayette, Ind., gave a paper before the convention of the Iowa Electrical Association at Sioux City, April 20, on the subject of meters, in which he took up the question of metering, especially in relation to complaints of consumers. He related how in small plants the consumer who thinks his meter is running fast pours his complaint into the ear of the bookkeeper, who knows little of such matters. The meter is then removed and sent to the factory for correction. The fact, however, that this meter was removed in itself does not remove the consumer's suspicion of the accuracy of the meter, but rather tends to confirm it. Mr. Tobias pointed out that even a rough test on the consumer's premises with lamps of approximately known wattage would be better than removal of the meter, because it would convince the consumer of its approximate accuracy. A test with a portable rotating standard test meter would be even better. Where the trouble is found to be not in the meter, the central-station man can frequently show the consumer where the extra consumption has come in by leaving lamps burning in unnoticed places. He told of one manager who, having gone over to the meter system of measurement from flat rates, received so many complaints from consumers about larger bills and inaccuracy of meters, that he wanted to go back to the flat-rate system. Such an attitude can only be due to improper handling of consumers, and a failure to show consumers that current metered has actually been used.

It is well known that meters are not usually fast. In fact, the First District New York Commission has found that of meters tested during a recent period, 5.8 per cent were slow and 1.8 per cent were fast. If a meter is found to be fast, admit it, and if it is more than 10 per cent fast make a rebate to the consumer for a reasonable period back. If the meter is of the commutator type, frequently all that is necessary is to clean the commutator with cotton tape. If that does not remedy the difficulty, test the shunt circuit to see that it has not been interfered with. He said that the majority of the commutator meters which are returned to the manufacturers from small companies need only a cleaning of the commutator to render them accurate. He recommended that commutators be cleaned every 90 days on commutator type meters which are used in factories where there is some vibration and dust.

A meter should be kept in the central-station office for demonstration purposes, so that customers may be shown the working of the meter and how turning on and off a greater number of lamps has a proportionate effect upon the meter. Showing a customer in this way wins his confidence. He also referred to the practice of one company of inviting the public to visit its plant three nights of every week, thus cultivating local pride in the concern.

In the discussion Mr. Austin Burt said that troubles with meters in his company were almost too small to consider. Of course, a regular meter-testing organization was maintained, and all meters are tested once a year. A meter tester is employed to test meters consecutively one after the other, as fast as he can get around. An average of 18 to 30 complaints per month are received that meters are not right. It is the invariable practice of the company to immediately send out and test such meters, and make a report to the customer on them.

He referred to some trouble arising from the lack of uniformity in the arrangement of connections on meters, even between meters of the same manufacturer. A case recently came up where a new type of meter was connected in, so as to cause a short-circuit. In the absence of any wiring diagram it was supposed that the connection on this meter would be the same as for other meters of the same make. He hoped that the day would soon come when meter connection would become standarized, not only as regards one manufacturer, but among all manufacturers, so that there will be a standard way of connecting up meters. This will tend to eliminate confusion and accidents.

Mr. Geo. S. Carson, of Iowa City, thought it very important for a company to have in its office a standard testing instrument in order to show customers the accuracy of their meters. The practice of granting a consumer a reduction on his bill without reason is very pernicious, because it indicates that the consumer can get a reduction by simply kicking for it, and also makes questionable the confidence which the manager has in his own meters.

Prof. A. H. Ford, of Iowa City, said that about 20 per cent of consumers' meters will usually be found 10 per cent slow, according to tests carried on by public service commissioners. Mr. Rufus E. Lee, of Clarinda, said that his company never compromised a bill—that is, never gave a reduction from the reading without reason. They try to get the customer to test his meter himself with lamps. The customer is usually looking for the meter to be 100 per cent fast, or some such figure. When he tests with lamps and finds that it is nearly accurate, he loses interest.

OVER-ALL EFFICIENCY OF ELECTRIC PLANTS.

At the recent convention of the Missouri Electric, Gas, Street Railway and Water Works Association, held at Jefferson City, Mo., April 14 to 16, Prof. H. B. Shaw, dean of the engineering school of the University of Missouri, called attention to the instructive results to be obtained from examining electrical generating stations critically, making general analyses of losses. Under the most favorable circumstances, he

said, for practical every-day operation only from 10 per cent to 14 per cent of the energy in the coal becomes available as electrical energy, the remainder being lost as heat in chimney gases, in radiation and in the exhaust, besides minor losses. The ratios of net electrical energy output to gross energy input as stored chemically in the coal used is generally known as the "over-all efficiency." It may also be stated as the efficiency from coal pile to busbars.

The over-all efficiency is the best measure of operation of different plants that has yet been devised. It may be expressed in per cent, the output and input being reduced to common units, or it may be stated in terms of pounds of coal per kw-hour. To reduce pounds of coal per kw-hour to over-all efficiency in per cent it is necessary to know the heat units per pound of coal used. To illustrate, for the bituminous coal used in Missouri the pound-Fahrenheit heat per pound will probably lie between 9000 and 14,000. One kw-hour is equivalent to 3412 heat units. So over-all efficiency equals 3412 divided by the heat units per pound times pounds per kw-hour. For coal of 9000 heat units,

$$\text{the over-all efficiency} = \frac{3412}{9000 \times \text{pounds of coal per kw-hour.}}$$

If the over-all efficiency, expressed as pounds of coal per kw-hour, be known, the fuel cost per kw-hour is easily obtained; for example, for a plant which requires 10 lb. of coal per kw-hour, the coal costing $2 a ton, or one-tenth cent a pound, 10 lb. then cost 1 cent, which is the fuel cost per kw-hour.

It is generally known that one of the largest items of cost is fuel. For example, the ratio of fuel cost to total operating expenses varies in the eight stations of the Boston Elevated Railway for 1902 from 47 per cent to 64 per cent, with an average of 61 per cent. This test was intended to prove that this company was justified in operating eight direct-current generating plants in place of one alternating-current plant with rotary-converter substations.

Hobart, in his recent book, "Heavy Electrical Engineering," gives the following instance of a representative station in Great Britain:

Output = 1,500,000 kw-hours per year; load factor = 22 per cent; heating value of coal = 7500 kw-hours per ton of 2200 lb. = 11,600 heat units per pound; coal burned = 6700 tons (2200 lb.) per year.

Reducing to units with which Americans are more familiar: $6700 \times 2200 = 14{,}740{,}000$ lb. of coal per year. The over-all efficiency then is

$$\frac{14{,}740{,}000}{1{,}500{,}000} = 9.8 \text{ lb. of coal per kw-hour,}$$

or

$$\frac{3412}{9.8 \times 11{,}600} = 3 \text{ per cent.}$$

In order to obtain definite data on the actual operation of Missouri electric plants blanks were prepared by the writer and sent to 180 such plants in the state. Only 13 replies were received—so few that it appears unwise to draw any definite conclusions.

Gas-electric plants will, in general, show higher efficiencies than steam-electric plants, and Diesel engine plants should show still higher over-all efficiencies.

After considering steam electric plants, which in large sizes may give an over-all efficiency of 10 per cent, or slightly greater, say, from 2.5 lb. to 4 lb. of coal per kw-hour, and in small sizes giving over-all efficiencies of 3 per cent or less, say, from 9 lb. to 20 lb. of coal per kw-hour, it is quite interesting to turn to a 100-hp, self-contained plant which claims the world's record of 1.04 lb. of coal per brake-hp-hour, say, 1½ lb. of coal per kw-hour. This is evidently a test result, but shows what may be done by jacketing, superheat and condensing.

To conclude, it appears that one of the best bases on which to compare electric plants as to operation is over-all efficiency. To get the over-all efficiency at all accurately, a totalizing watt-hour meter or watt-hour meters for each generating unit are necessary. In how many plants do we see a multiplicity of ammeters on different phases, together with other instruments, and how astonishing it is to note the lack of watt-hour meters in the station, though one may be installed for each consumer. The use of such instruments, said Professor Shaw, together with study of data on over-all efficiency, may result in considerable decrease in operating charges.

These remarks would not be complete, added the speaker, without referring to the firing of coal and its effect upon the over-all efficiency. Probably in no other way may the operating charges of an existing plant be decreased so much and the over-all efficiency so materially increased as by introducing and keeping proper methods of firing. In some cases this necessitates the installation of a CO_2 recorder to get exact data on chimney losses.

Supplementing Professor Shaw's remarks on firing, Mr. P. A. Bertrand, of Jefferson City, Mo., remarked that the men in the fireroom usually tend to employ low heats, in that way getting easier firing. The best results, he said, were obtained when all individual boilers in service are well loaded, as the water-tube type of boiler shows a sustained high efficiency at from 100 per cent to 126 per cent of its rated capacity. Cheap firemen, said Mr. Bertrand, are worse than no firemen at all, and he advocated the payment of sufficient wages to secure a fair order of intelligence in the fireroom.

MOTOR APPLICATIONS.

Mr. Harry Glass presented a paper at the convention of the Minnesota Electrical Association, in March, giving some specific examples of the application of electric motors by central stations which might be helpful to other central stations seeking similar classes of business. He stated that to apply motors invariably to machines by replacing a lineshaft pulley by a motor pulley and belting a constant-speed motor to the machine will not always give the greatest economy and satisfaction possible with electric service. The characteristics of the motors and their limitations, as well as the operating characteristics of the machines in the particular shop where they are to be installed must be determined. The solicitor must be able to see the possibilities of the machine before the change is made. The paper presented a variety of examples of changes from mechanical to electric service, some of which required a careful study of operating conditions, with modifications of the machine or motor to fit, and some where central-station service resulted in a material change in manufacturing conditions.

A newspaper plant in Youngstown, Ohio, printing from 15,000 to 20,000 copies daily was changed from gas engine to individual-motor drive. Much trouble had been experienced with the newspaper press because of uneven speed which tore the paper. Each tear meant stopping the press and a serious delay, which sometimes occurred several times an hour. A 30-hp induction motor of the wound-secondary type with external resistance for starting and running duty was belted to the press through the existing mechanical speed-changing device. The result was that the paper tears only about once in two or three weeks when a bad place in the paper occurs.

A gas-engine factory in Oil City, Pa., in the natural-gas territory, where gas engines are manufactured for oil wells (and where the load used in testing the completed engines is obtained by driving the factory shop equipment itself) adopted electric service on the initiation of the managers, who were interested in a wood-working plant recently equipped with individual motors. This was done in spite of the recommendation of the central-station company to continue the use of the gas engines. It is significant when a manufacturer of gas engines, who is really obtaining his power for manufacturing without cost, decides that the convenience and reliability of purchased electric energy warrants its use in his own factory.

A planing mill doing jobbing work of a general character,

mainly on soft wood, was driven by a single steam engine with line and jack shafts. A few of the machines were equipped as follows: A double 30-in. blower was driven by a 30-hp motor, with a double extended shaft carrying the four blades. This was mounted on a special platform suspended from the ceiling. A four-head (13-in. inside) molder was driven by a 30-hp wound-secondary type induction motor, mounted on the ceiling and belted to a countershaft. A 24-in. matcher was driven by a 20-hp motor, belted from the ceiling above to the machine pulley. Most of these latter were equipped with wound-secondary motors, as they were in locations where brush care was easy. A 24-in. rotary-bed pony planer was driven by a 20-hp motor, mounted on the ceiling below the machine and belted to a countershaft on the same ceiling. Two belts were run through the floor to the machine and protected by guards. A 10-in. four-head molder, driven by a 15-hp motor, was mounted on the ceiling above and belted through the machine countershaft. A baling press, making two bales 16 in. x 16 in. x 32 in., required a reverse motion to run the head back. Rather than involve the fire risk in connection with apparatus for electrical reverse of the motor, it was considered better to put in a countershaft with open and crossed belt and idle pulley. As the motor was located inside a building used solely for shavings and products, a squirrel-cage secondary with oil-immersed auto-transformer starter was decided upon. The motor was a 7.5-hp machine.

A single spindle shaper, formerly driven by a quarter belt with reversing gear, occupied too much space. A vertical motor was placed beneath the table of the shaper and belted to a vertical countershaft at the opposite end of the table, and from that to the spindle pulley. The motor was a vertical-shaft, squirrel-cage, 5 hp machine. A small jig-saw is driven by a 1-hp squirrel-cage motor mounted on the under side of the table top and belted by a short belt to a tight and loose pulley on the crankshaft which drives the saw. This method has proved entirely satisfactory.

This complete installation has 231 hp connected in a total of 31 motors and employs from 7 to 10 machine operators and five benchmen. The old boilers have not been replaced, but are operated at low pressure for the dry kilns and the heating system. The greater part of the refuse is sold baled or loose and brings an average gross income of approximately $90 per month. The total energy consumption has averaged about 6600 kw-hours per month, which corresponds to about 32 hours' monthly use of the connected load.

A wagon shop was changed from steam drive to group and individual-motor drive. In the wood-working shop the line-shaft was divided into three sections and driven by two 10-hp and one 15-hp motor. From the shaft are belted 21 different machines, and in addition there are several motors in the blacksmith's shop, which bring the total horse-power up to 53. The kw-hour consumption was equivalent to 23.7 hours' use per month of the connected load in 1907, but in 1908, after the panic, this was cut down by almost one-half.

When installing electric drive in the scrap yard of a small steel mill it was desired to use a magnet for handling the scrap iron. The alternating current of the central station could not be used in this magnet. Alternating-current motors were used to drive the crane, the hoist and the carriage, but for the magnet a 5-kw motor-generator set had to be installed. This set is suspended from the monorail just ahead of the carriage and is moved by the carriage motor.

Mr. Glass described also the installation of alternating-current motors throughout a large cast-iron pipe foundry. This foundry offers an extremely desirable class of central-station load because it is not in use during the peak. The main load is produced by the positive-pressure blowers, which cause a total maximum load of approximately 1000 hp from 9 a. m. until about 3 p. m. The load at other times is comparatively small. The total energy consumption per month in 1908 averaged 38,970 kw-hours. This is approximately 7 per cent of the amount which would be used if the maximum load had run 24 hours per day, 30 days per month.

SECURING OFF-PEAK LOAD.

In a paper on "Securing Off-Peak Load," read by Mr. Harry G. Glass, of Pittsburgh, before the Iowa Electrical Association, at Sioux City, April 21, some of the methods were reviewed which are used on a large system in Pennsylvania which serves many large and small towns.

A flat-rate circuit was run for tungsten display lighting. The tungsten lamps used were plainly stenciled so that none but lamps owned by the company could be used without danger of detection by an inspector. In the introduction of electric household devices a limited number were put out on trial to get them started. The plan which proved the most successful in the case of flatirons was to issue a certificate for $2 worth of energy, redeemable if presented within 30 days from date, together with $2 in cash in payment for the iron. The idea was to put the iron out on trial for 30 days and force the customer to decide within that time or pay full price.

Sewing-machine motors were the best apparatus obtainable for popularizing the use of electric current, and cut-offs were often saved by persuading a dissatisfied customer to try out a motor for a few days. Practically the same plan was adopted in selling toaster stoves as with flatirons. These give even better revenue than irons, although their use has not become so general. The statement has been made that one steam engine supplanted by an electric motor will add to the station revenue more than all the heating devices on the system. This may be true if the motor be large enough, but heating devices are, as a rule, used on meters already installed for lighting service and this kind of servive pays the highest net rate of any day load. Off-peak motor load, however, is absolutely necessary to the successful operation of a central station, and the management, as a rule, will realize this and make every effort to increase the load factor thereby. Classify the possible power prospectives in your territory and go after the ones for whom the most money can be saved and who will consequently prove the best boosters for the service.

A few arguments which have been found effective and which can be used in going after any class of day business, are as follows: Less cost; safer; cleaner; less fire and accident risk; more flexible; no pipes to burst; increased motor installations as growth of business demands; the company provides labor and furnishes the final product, energy; steadier operation, consequently less repair; less noise; easier to operate; power always ready; insurance rating reduced; no worry about power plant; costs nothing while not in use; no steam to raise; less investment; less line shafting; absence of an isolated plant allows better ventilation and lower temperature; rental value of building increased; space required for power plant can be used or rented; no risk of boiler exploding or flywheel bursting; easier to keep a record of power costs.

In going into a profitable load-factor increasing campaign the first essential is service. One must be prepared to give service which will be at least more reliable than that which prospects have been using in the past. The second essential is proper spirit in the organization. If all feel that they are working for a company which has a good thing to sell and they must demonstrate that this is true, it is certain to so take possession as to leave no room for other spirits.

The question as to whether the central station should sell motors to customers has been discussed more than any other thing connected with this class of business, except the question of rates. Experience has taught that the company should at least be in a position to do so, but as to actually doing it depends entirely on the local conditions. If the dealer in the field handles a good type of motor and installs them at a reasonable profit, the central station should give him all the help possible; but if there are cases where the central station must handle the sale of motors at cost on account of the size of the account, terms of payment or the possibility of losing a contract for energy, it should be in a position to make the sale and should be close enough to the dealer to tell him why this was done.

In the discussion, Prof. A. H. Ford, of Iowa City, said that a rate for motors should combine a fixed demand charge with an energy or kw-hour charge. He then showed how the demand charge should be fixed by the time at which the maximum demand comes with reference to the peak demand on the station. A kind of load which has a peak at some other time than during the evening peak load of the year does not involve as heavy a fixed investment, and hence the fixed demand charge should be less than if the same load were used at the peak. In many cases in the manufacturing business the peak comes at 11 a. m. and the motor load is rapidly dropping off at 5 p. m. as the yearly lighting peak is coming on. City water pumping can be taken at a very low rate if there is a standpipe and the pumping can be done when the generating apparatus is not in use to carry the peak load. Such pumping load can be taken at a rate which is but little more than the operating charge. He gave the ordinary cost of running a gasoline engine as 2 cents per hp-hour. Operating with illuminating gas at usual prices will cost from 2.5 cents to 3 cents per hp-hour. The first cost of an electric motor is about half that of a gasoline engine of the same power.

Mr. Glass, as an example of off-peak rates, cited the case of a large pipe mill which had its maximum demand occurring between the street-railway peak demands each day. On account of the nature of the demand this business was taken at a rate of 1.5 cents per kw-hour with a minimum bill of $600 per month. A glass plant offers a different character of load, which is on 24 hours per day, seven days a week. As a striking testimonial to the superiority of electric service, he mentioned that in a Pennsylvania town of 17,000 population where natural gas for engines sold for 8 cents per 1000 cu. ft., all the gas engines in town but one had been shut down by electric motors.

Mr. Austin Burt, of Waterloo, said that in the last three months he had contracted for 1200 hp in five contracts with farm-machinery manufacturers, with the provision that these factories will shut down previous to the company's peak lighting load during late fall and early winter. This showed what can be done in the way of persuading manufacturers to make slight changes in hours of work to get cheaper power. He had not found it a very difficult matter to get the manufacturers to consent to make such changes.

INTRODUCTION OF TUNGSTEN LAMPS.

At the convention of the Minnesota Electrical Association, held at Minneapolis, March 29 to 31, Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, gave an informal talk on the trend of the times as regards electric lamps. He said that a year ago in a talk which he had made, he had said that the previous year had been one of such interest in lamp development that it was not likely to be duplicated soon. However, he could conscientiously make that statement again this year about the past year. One of the notable developments of the year is that the manufacturers of the world have come together for the technical development of the tungsten lamp. He said that investigation disclosed the fact that there are about 30 men in the world qualified for the highest class of research work. There is a radical difference between the research work which was necessary in connection with the carbon-filament lamps and that necessary for the tungsten lamps. The tungsten lamps offer more problems in ordinary chemistry, while the carbon filament was a special branch of high-temperature furnace work or high-temperature chemistry about which very little was known generally before the development of the lamp. Of the 30 investigators mentioned, six are at work in the United States, with about 75 assistants. Abroad there are more men competent to conduct research work, but they have less money at their disposal. The lamp situation, he said, is one which was never before duplicated in the commercial history of the world. All of the great commercial interests connected with the lamp industry are now working together for the development of the tungsten lamp.

He said that a lamp consuming 0.5 watt per candle is not out of reason. While it may not be expected next month or next year, he thought it not at all unlikely that it will appear within the next five years. Mr. Doane referred to the adoption of tungsten lamps of low wattage by some central-station companies. He said that the companies adopting these low-wattage lamps had also adopted a low e.m.f. of 50 volts or 60 volts in order to obtain lamps of greater durability. This is the practice at Hartford, Conn. There has been some development in tungsten lamps of lower candle-power and also some in the opposite direction of very high handle-power and wattage. Foreign lamps of 400 watts or 500 watts have been put on the market. American manufacturers are trying out the 400-watt size, but it is not ready for the market.

He then took up the attitude of central-station companies toward the tungsten lamp. He reviewed how the central-station companies of the country would be eager to take advantage of economies in boilers and turbines. He showed how quickly central-station companies would take up with a boiler, for example, which would give double the amount of steam per pound of coal, or with a steam turbine which would give double the kw-hours per pound of steam. When it comes to the tungsten lamp, however, which makes a great saving in the cost of producing light, the central station is not so quick to adopt the change, some having taken up with the policy of introducing tungsten lamps only as fast as the natural growth of the business. The whole trouble is that the saving caused by the tungsten lamp comes on the consumer's side of the meter. He asked for the opinions of the central-station men present as to what they wanted the lamp manufacturers to make for them.

Prof. George D. Shepardson advocated the change in method of selling energy by central-station companies, so that they will sell candle-hours instead of kw-hours. Then the consumer and company would share the benefits brought about by lamps of better efficiency.

Mr. Ludwig Kemper, of Albert Lea, said that he had pushed tungsten lamps for places of business where they were properly installed and controlled by switches. For such use they have been very successful. However, when the smaller sizes of tungsten lamps were used in residences, where they were on low fixtures controlled at the socket, the breakage had been abnormal and the result unsatisfactory.

As regards the question of breakage, Mr. Doane said that tungsten filaments of great strength have been produced accidentally in the laboratory, and he thought it would only be a question of time until such filaments could be made systematically when once the necessary process was located. Mr. Doane thought it essential that central-station companies have control of the lamps which go onto their circuit.

Mr. Harry Glass, formerly of the West Penn Railway Company in Pennsylvania, told of a plan of operating flat-rate circuits for tungsten lamps only, which was put in operation in a number of small towns operated by the West Penn Railways Company. A separate system of primaries, transformers and secondaries was installed in these small towns covering the business district. A flat rate was made on this class of business of a certain amount per candle-power per month. This flat-rate circuit was turned off at 11 o'clock every night except Saturday, when it was turned off at midnight, and Sunday when it was turned off at 10 p. m. This flat-rate circuit took in most of the sign and display lighting and also lighting of store interiors in the town. This flat-rate scheme was later put into operation in the larger towns of the system.

Mr. Robert W. Clark, of the Minneapolis General Electric Company, said that his company had been early in the game of pushing the tungsten lamp and had advocated them so actively that it had done everything short of positively refusing to sell carbon lamps to customers. As regards the use of tungsten lamps in residences, he said there was no trouble with modern fixtures from the breakage of tungsten lamps in residences. Such fixtures are usually out of reach and controlled by switches. The central station should always be in favor of anything to save energy for the consumer. The increasing number of consumers will compensate for any loss of gross revenue.

In answer to a question as to whether the proposed 10-watt sign lamps are now available, Mr. Doane said that the 10-watt lamp is now on the market, and also one taking only 2.5 watts. Mr. Clark called attention to the fact that on very large signs which are seen from a long distance, the 10-watt lamp is better than the 5-watt lamp, even though the same total wattage be used on the sign. The reason for this is that viewed at great distances it makes little difference whether there are two 5-watt lamps or one 10-watt lamp.

Mr. Glass pointed out that the flat-rate system had the objection that frequent inspection is needed with it to see that the consumer does not substitute lamps of higher candle-power than contracted for. In order to overcome this objection, the company he spoke of had secured lamps from the manufacturers which had a special mark on the bulb which was very evident by casual inspection. In this way none but lamps furnished for the company could be used on the system without danger of detection. All of the lamps used on this flat-rate system were in places where inspection was easy. For this reason the flat-rate system was not adopted in residences, as it was not thought desirable to cause residence consumers the trouble of admitting inspectors frequently to all of the rooms of the house.

Mr. R. W. Clark, of Minneapolis, said that he could not see the danger of reduction in revenues from the use of higher-efficiency lamps. The consumer takes the money which he would otherwise be spending for lighting and spends it on energy used for flatirons and other electrical appliances, which are not on during the peak. The practical effect of the higher-efficiency lamp is, therefore, to reduce the maximum demand and to improve the load factor on the station.

In answer to a question by President Gille to the feasibility of making 25-watt tungsten lamps with opal glass, Mr. Doane said that there is much difficulty of manufacture because it is necessary to insert the filament during the process of manufacture, and this cannot easily be done with opal bulbs. A bulb which can be frosted after the lamp is finished is, therefore, preferable.

SECURING PROFITABLE DAY LOADS.

Large and small central stations alike realize the importance of giving more attention to the building of an off-peak load. Mr. J. E. Harsh, in a paper before the Missouri Electric, Gas, Street Railway and Water Works convention, at Jefferson City, April 14, treated the subject of small motor and heating appliance business as one of the most important factors to be considered when filling in the hollows of the load curve. An abstract of his paper, it is believed, will be of interest to many central-station managers.

The profitable value of a day load, Mr. Harsh pointed out, depends upon how evenly distributed it is throughout the day and what percentage of it laps the peak. Such day loads are of two kinds: industrial and domestic. In the former class are included such appliances and devices as are used in a manufacturing and commercial way, embracing motors, heating appliances, fans, etc. The domestic field includes devices particularly applied to use in the home, such as electric irons, toasters, etc.

It is through specialization that a central station can produce the best results, giving the best revenue-producing appliances the first consideration, and specializing along such particular lines, until this demand is well enough established to allow more time being given elsewhere.

The threatened installation of isolated plants requires prompt action on the part of the central-station management, for it should be recalled that, whenever an isolated plant is installed, the prospect of some day load from that source drops out of sight, and usually stays there until the plant begins to deteriorate and a few of the disagreeable features of its operation become more pronounced to the owner. In the meanwhile, the central station has lost the revenue, and allowed an installation to go in which will have its bad effect upon other prospective customers. The cost of soliciting the business of an isolated plant is also far greater after its installation than before.

The application of motors has broadened and developed wonderfully during the past few years. Central stations are discovering that classes of business which have heretofore not been considered worth striving for have developed into very profitable revenue producers. Each central station, of course, has its individual situation to cope with, the size of the city governing the number and variety of the larger propositions, but there is one class of business which affords every central station, large or small, an opportunity to secure some profitable day load. This class is the small-motor business. A town may have only one mill or one factory, but it is safe to assume it has bicycle shops, blacksmith shops, confectioneries, carpenter shops, groceries, dentist's offices, drug stores, harness shops, jewelry shops, meat markets, printing offices and a number of other concerns which require energy for operating lathes, drills, blowers, saws, coffee mills, meat grinders, ice cream freezers, presses and dozens of other devices which are often operated by other forms of energy, frequently by hand or footpower. These can be converted to the use of motor drive by persistent and intelligent solicitation.

The growing popularity of electric refrigeration opens up an excellent field for commercial activity. Good returns are also secured from electric-automobile charging devices. Even in the smaller towns, electric delivery wagons and trucks are becoming more popular each day.

Electrical pumping is proving to be a good load, and more attention is being given to it than ever before, especially among the small users. Motors for hoisting and operating concrete mixers are used almost entirely off peak. Builders and contractors are being rapidly converted to the use of electric power for this purpose. Vacuum cleaning machines and plants for use in residences and business houses, also portable electric motors for operating floor-dressing machines, all go to make up a profitable day load. While the revenue secured from small motors is not large, except in the aggregate, the size of the field and the fact that the load is almost entirely off peak, warrants considerable effort being extended along that line. Practically every business house can contribute its share towards a profitable day load.

The largest and most profitable business is obtained through direct personal solicitation. Where the field is broad enough to permit, the services of a competent solicitor should be secured. Special attention should be given to the securing of off-peak business. Special contracts can be made in which the consumer agrees not to use energy during certain specified hours. Small central stations sometimes fall a victim to a fixed straight-rate meter charge for energy, with no minimum charge for each horsepower connected. This rate is often prohibitory to large and long-hour consumers, and with no minimum a company soon discovers a number of unprofitable installations connected to its lines.

Prospective customers are sometimes persuaded into investing in motors from 20 per cent to 30 per cent greater rating than is actually needed. This, sooner or later, leads to a dissatisfied consumer, and is certainly not beneficial to a central station. A satisfied consumer is one of the greatest advertising assets any company can have; therefore, the most careful attention should be paid to getting accurate estimates, of operating costs, etc.

Mr. Harsh stated that his experience had demonstrated the following tactics to be effective in the stimulation of the growth of new business:

Newspaper descriptions of local motor installations make interesting reading for the prospective customer, and hasten indirect influence over some of the most stubborn. Illustrated booklets sent to prospective customers, showing illustrations of the application of electric motors, are very helpful to the solicitor. Included in this, should be some condensed arguments with reference to the illustrations. A motor display room should be fitted up if possible, and should show motors hanging from the ceiling and on the wall, thus demonstrating economy of space, etc. Motors should be connected so that a complete demonstration of their operation can be carried out.

Experience in soliciting lighting business has indicated the advisability of submitting sketches showing suggested lighting

arrangements. There seems to be no reason why the same course should not be pursued when dealing with prospective motor users. A sketch of a proposed motor installation may be the means of closing an important contract.

The system of placing motors out on trial finds favor with some central stations. As a rule, a company is quite safe in placing an installation of this sort, particularly in small units. The prospective customer can be required to stand the cost of wiring, etc., thus assuming a portion of the expenses incurred. A few central stations make a practice of renting motors. However, in most localities, supply men take up, or can be induced to take up, this end of the business, thus relieving the central station from the additional investment and care. The rental plan has its disadvantages, since an investment by the consumer insures a longer guarantee of use, and allows the central station a greater independence.

The plan of selling motors on payments has been taken up with success by a great many companies. Motors make a safe investment, since their depreciation is so small. Frequently the initial cost, often amounting to a considerable sum, stands in the way of closing a contract.

The progress made in the installation of electrical heating devices in any locality depends to a great extent upon the relative prices of electric energy and fuel. Some profitable business of this nature can always be secured. Wherever cleanliness and convenience are considered, it is not difficult to install electric appliances. Laundries, tailoring, cleaning and pressing establishments, etc., afford a good field for heating devices, particularly electric irons.

In the manufacturing end, glue pots and soldering irons produce very good revenue, and are among the most popular heating devices. Electric water heaters are becoming more useful and economical. Electric hot-water urns for the barber shop, the saloon and the drug store can usually be installed with success. All heating business is profitable, being almost entirely off peak; consequently, where the business warrants, a special rate can be given.

The fan business is receiving more attention than ever before. It is exceedingly profitable, since it comes at a time of year when it has least effect upon the peak. Probably the best system of handling the fan situation is on the flat rate basis. Some central stations have in successful operation a fan rental system, both with meter and flat rate. From the central-station standpoint, the flat rate should be pushed, since it provides a guaranteed amount of revenue, and requires no meter investment. The success resulting from the universal method of placing other appliances out on trial leads one to believe that good results could be obtained through installing fans on that same basis.

From a domestic standpoint there are a great many electric appliances, a few of which are worth specializing upon. Central stations are centering their efforts with good results upon the sale of electric irons. The high wattage of the iron, together with the fact that it is seldom if ever used on the peak, makes it very profitable business. Irons can be of material assistance in increasing the amount of the minimum bill during the summer months. It is also the usual experience that, where once installed, they are used practically the year around. To the 30-day trial system is due much of the success obtained in pushing the sale of electric irons. The plan of loaning irons for an indefinite period has been tried without success. This plan entails the loss of a good many irons, besides requiring a large investment and extra work. The most popular method of introducing the electric iron is probably the "iron-wagon," a conveyance, loaded with a supply of irons, which is used in a house-to-house canvass by the solicitor.

Some companies employ young lady solicitors, who devote their entire time to the sale of irons and other electrical appliances. Other companies deliver the irons upon requests sent to the office, or secured by their regular solicitors. The first plan is more generally adopted, since the solicitor's trial offer, backed up by the iron in his hand, has a more convincing and appealing effect upon the housewife.

Some manufacturers of irons and other domestic appliances have in their employ salesmen trained especially in the work of introducing irons, toasters, etc., into the home. Any central station desiring to specialize upon the sale of electrical appliances can secure, without cost, the services of one or more of these solicitors, by purchasing the appliances from the manufacturer.

The electric toaster, having about the same current consumption as the iron, is coming more in demand. The trial proposition in connection with the toaster is being tried out by a few companies. Reports from one company show that out of one thousand toasters placed on trial, about 50 per cent were purchased. This is very encouraging for an introductory effort.

In still another direction, profitable day business can be secured in the long-hour burning of electric light. Merchants in practically every town or city find it necessary and convenient to use artificial illumination during the day, and this could be encouraged through the application of a sliding-scale rate.

That the quickest and best results are obtained through personal solicitation, is conceded by all central stations which have made a special campaign along this line. However, personal efforts can receive good support through the use of judicious advertising, and by any other means which will assist in popularizing the use of the commodity offered.

A good display room is quite an important factor in business getting, since it affords the people who come to the office to transact business an opportunity to become interested in the goods displayed.

Office demonstrations held at certain intervals or during the discount period, have a tendency to bring more consumers to the office, where they can be interested in electrical devices.

The loaning of appliances to clubs and church orders, also to ladies entertaining at home, is found to be a successful means of introducing appliances.

Where found advisable, special letters can be sent to prospective consumers, accompanied by other advertising matter which might suit the occasion. Central stations will also find many of the large supply houses ready and willing to co-operate by furnishing advertising matter free of charge.

The important feature to be kept in mind in the securing of a day load, said Mr. Harsh, is that most of this business occasions very little expense, outside of the first solicitation. The main essential, in the securing of such a load, is persistent and systematic effort expended along the right lines.

In the discussion of Mr. Harsh's paper, Mr. J. A. D. Cross said that in small towns the use of the special demonstrator had proved a successful way of introducing heating appliances, but that the expense of this method, including railroad fares and demonstrator's expenses, when figured in terms of the actual business done, frequently appears disproportionately large. He suggested the less expensive way of instructing some local woman or department store employee to give demonstrations, and also advised the loan of devices to social meetings. Mr. R. J. Irvine pointed out that companies operating both gas and electric properties might experience a diminution in their gas sales as the result of electric-iron campaigns, but Mr. Harsh reported that the experience of the Denver company, with which he had served, showed practically no results in the decrease of gas following the introduction of electric irons, although careful examination of customers' bills was made.

Mr. C. L. Clary told of a highly successful method of placing electric irons which has been adopted by his company, and as a result of which 80 per cent of his resident consumers now have irons. The irons are first placed out on 30 days' trial, at the end of which time a contract slip is presented to the customer by which the iron is loaned further, a deposit of $5.00 being made, which is redeemable at any time on demand. During the time of this loan the company makes all repairs. The idea of an indeterminate loan has been found to appeal to the customer more strongly than an outright purchase, while at the same time the company enjoys the revenue from the use of the iron and has made a virtual sale, as few of these irons are returned.

Wiring and Illumination

THE DISTRIBUTION OF ARTIFICIAL LIGHT.

The importance of good lighting in the textile industry formed the subject of a paper by Mr. Frank M. Scantlebury read at the Boston meeting of the National Association of Cotton Manufacturers, April 27 and 28. It was stated that about 50 large mills are still using gas in New England alone, whereas, with electricity, these establishments could not only secure much better light, but could increase the efficiency 50 per cent at an increase of about 25 per cent in cost over gas. The author considered it a safe estimate that some $20,000,000 worth of illumination is annually wasted in this country by the failure to control the illumination itself. The economies of the metalized-filament incandescent lamp were emphasized, and the tungsten lamp was praised for its light quality in connection with the comparison of color values. The principles of reflection were discussed briefly, and the distribution of illumination from spun-steel reflectors shown. The author emphasized the folly of trying to economize in light at the expense of the operator's work. To control fully the light given off from a lamp it is absolutely necessary to cover at least three-fourths of it with a reflector.

The use of an ordinary carbon lamp hung about 6.5 ft. above the floor was criticised, and the improvement gained by the use of a steel-cone reflector mentioned. By the use of a 60-watt tungsten lamp with appropriate reflector the author stated that while only 4 per cent more power is required than with the old carbon lamp, the light by actual photometric tests on the looms is about 300 per cent better with the tungsten lamp. A bowl reflector and 60-watt tungsten lamp used over sorting tables give good results. Glass reflectors are valuable when well out of reach of the operators.

The use of arc lamps has proved a poor solution of the problem of general illumination in textile mills. Large tungsten units are inadvisable unless they are used plentifully or placed high above the floor. The paper closed with the recommendation that skilled illuminating engineers be consulted by mill managers desirous of obtaining the best results in service.

ORNAMENTAL STREET LIGHTING IN INDIANAPOLIS, IND.

The movement for a better system of street lighting for the business section of Indianapolis, Ind., has been under way only since the first of the year and yet there has already been installed over 200 posts and there are about half as many more contracted for. Washington Street, a view of which by night is given herewith, has 133 posts erected; Meridian Street, from Washington Street to the Union Station, is completely equipped with the new standards, and Illinois Street, from Washington Street to the Union Station, is also fully equipped with tungsten lamps. This section of the city has undergone a wonderful change and now possesses one of the most beautiful and effective systems of ornamental lighting yet installed.

The system as installed in Indianapolis, comprises five-lamp standards equipped with 100-watt tungsten lamps. The standards are spaced 84 ft. apart on both sides of the street. There are thus 12 standards to a block, and the lamps burn from dusk until midnight every night of the year. The electric energy is supplied from feeders in a 4-in. tile conduit set 1 ft. under the pavement in the gutter close to the curb. All poles on each block are controlled by one switch in the base of the corner pole. Lead-covered cables are used of sufficient size to permit flat-rate windows and signs to be fed from the same circuit.

The charge for energy is based on the ground-floor tenants foot frontage, and is at the rate of $1.05 per foot front per annum. At this rate the post is furnished, installed and equipped, kept in repair and the lamps lighted. The rate is based on a five-year contract and it is expected that when the campaign is completed Indianapolis will have about 400 posts. The business is secured by direct solicitation and with the help of several merchants' associations in some of the blocks. In the latter case the Merchants' Heat & Light Company is practically relieved of all soliciting, the merchants taking up the matter themselves. The greater part of the signatures were secured by the electric light company's solicitors, however.

Ornamental Street Lighting in Indianapolis, Ind.

INCREASING USE AND INSTALLATION OF HIGH-VOLTAGE MOTORS.

By G. J. Kirchgasser.

The use of high-voltage alternating-current motors in industrial plants may seem questionable at first; but the number of new installations has been increasing with apparently satisfactory results. It would be unwise to think of using them for driving small machines scattered about a factory, but there is a field for which high-voltage motors are well adapted.

About 10,000 hp of 2200-volt motors are using Niagara energy in Buffalo. These motors are mostly of large size, the smallest in service at this voltage being rated at 20 hp and the largest 1500 hp. The Cataract Power & Conduit Company has two terminal houses connected to American and Canadian power plants and four substations. The substations receive the energy by underground cables at 11,000 volts and deliver it overhead, after transforming, at 2200 volts. The motor circuits are all three phase. Over 5000 hp of these motors are in service 24 hours a day, making a very desirable load.

The United States Government uses motors to pump the

water from the cofferdam at Black Rock lock. Four pumps are run continuously so that the concrete work for the lock can be carried on. At the Buffalo water works two 1500-hp motors have been in use for several years, while the third has been in operation about a half year. These are all vertical motors mounted at the upper end of the pump shaft; the pumps are of the two-stage centrifugal type. As far as the writer has been able to ascertain, satisfactory results have been obtained. One advantage of the use of motors operating at the voltage of the distributing company's lines is that no transformers are necessary, which means the saving of installation, wiring and transformer loss. No transformer houses are needed unless, of course, motors of another voltage or lamps are also in use. Where large units are run during long periods with infrequent stops and where other conditions are favorable, the 2200-volt motor is well adapted. In buying large quantities of electricity at the distributing voltage low rates are charged. The Cataract Power & Conduit Company's advertised wholesale rate system is as follows. The maximum amount of energy used at one time during the month is charged for at $1 per kilowatt rating plus an additional charge per kw-hour for actual energy consumed, as follows:

For 1,000 kw-hours or less per month	$0.0200
Excess over 1,000 up to 2,000 kw-hours	0.0150
Excess over 2,000 up to 3,000 kw-hours	0.0120
Excess over 3,000 up to 5,000 kw-hours	0.0100
Excess over 5,000 up to 10,000 kw-hours	0.0080
Excess over 10,000 up to 20,000 kw-hours	0.0075
Excess over 20,000 up to 40,000 kw-hours	0.0070
Excess over 40,000 up to 80,000 kw-hours	0.0066
Excess over 80,000 kw-hours	0.0064

The wholesale rates apply also to those who transform to other voltages as long as it is received at 2200 volts.

The location of a high-voltage motor is of considerable importance. At the water works they are in the main pump room, the leads, lead-sheathed wire, running beneath the floor. Each unit has an attendant. In a plant of this kind there is not the same amount of danger from accident as in the manufactory or industrial plant, where many are in employment. Motor rooms, therefore, some of non-combustible material, such as brick, cement or tile, and some of wood, are used to a great extent. As these are not used for any other purpose but as a housing for the motor, employees have no occasion to enter them. As little of the high-tension wiring is brought into the building as possible.

Where several motors are installed, the largest one is usually placed in the same room with the meter panel and service entrance. This panel is placed near the outside wall, through which the wires enter, and upon it are mounted a polyphase watt-hour meter, circuit-breaker and oil switch, shunt and series transformers, and at the top, for each phase, open-blade knife switches. Enclosed fuses are also mounted on the wall where the wires enter the building. The wires are supported on glass petticoat insulators, which hold the wires about 10 in. or 12 in. apart. This open wiring is also employed for the motor by returning up the wall to the ceiling and dropping to the motor terminals, the motor often being placed on a high platform. The circuits to other motors of the plant are run outside of the building, over roofs, etc.

Ceiling suspension is also used to some extent. A motor placed near an outside wall requires little wiring inside and this is out of reach. Where the motors are placed on the floor, lead-sheathed, multiple-conductor cable is run in iron conduit from the starting compensator to the terminals. The rules of the National Electric Code require that the sheath and conduit be grounded and the conduit bonded to the metal casings of all fittings and apparatus connected to the inside high-tension circuit. Signs are always posted conspicuously giving warning of the danger of the high voltage.

For the outside wiring glass-petticoat insulators are also used to support and insulate the wires, and where crossing roofs substantial structures are built on which the insulators are mounted. The wires are usually placed 7 ft. or 8 ft. above the roofs so that space is allowed for passing beneath. Firemen, roofers or other workmen might come in contact with the wires if they were allowed to hang low. Increased use of high-voltage motors may subsequently cause undue familiarity and carelessness, but with proper precautions and a standard installation there is no reason why the service should not be satisfactory.

TWO-WIRE 220-VOLT DISTRIBUTION.

Prof. George D. Shepardson in a paper before the Minnesota Electrical Association convention in March, discussed the advantages and disadvantages of 220-volt distribution for small central stations. Professor Shepardson first discussed the general principle that the higher the distribution voltage, the less copper wire is required for a given amount of loss in the line.

The relatively low all-day efficiency of the early alternating-current systems and the complication of the three-wire direct-current systems led to a demand for incandescent lamps, which could be operated directly from 220-volt circuits. These were introduced about 1892. Some of the earliest plants were in Minnesota. In the six years between October, 1894, and September, 1900, there were installed in Minnesota 69 central stations, of which six used the direct-current, three-wire, 110-volt system; 25 used alternating-current apparatus, and 38 used the 220-volt, direct-current, two-wire system.

In 1909 there were 166 central stations in Minnesota, with an aggregate equipment of 51,500 kw, with 700,000 incandescent lamps connected. Of these, 35 plants aggregating 25,000 kw and 179,000 connected lamps are using three-wire secondary systems; 17 plants aggregating 10,000 kw and 225,000 lamps use direct-current, three-wire system; a total of approximately 52 plants, aggregating 35,000 kw with 404,000 connected lamps, are using some sort of three-wire system not necessarily including the alternating-current three-phase system; 50 stations aggregate about 11,000 kw and supply about 200,000 lamps with approximately 110 volts over two-wire circuits; 63 stations aggregating 5600 kw supply approximately 102,000 lamps at 220 volts over two-wire circuits. Those supplying lamps at 220 volts vary from 15 kw to 400 kw in rating. These figures indicate that the special field for the 220-volt system is in a small town where the demand is limited and the load scattered.

The arguments against the 220-volt system center around the shortcomings of the high-voltage incandescent lamps and the difficulties of operating arc lamps satisfactorily on such circuits. The arguments in favor of the 220-volt two-wire system gather about the simplicity of the station equipment and wiring and the ability to reach economically the scattered load in small communities. While the use of high voltage is generally desirable from the standpoint of the line, the consuming devices generally favor lower voltage. Generally speaking, motors, lamps, cooking and heating utensils cost more as the voltage is increased. Arc lamps operate at the highest efficiency at from 40 volts to 60 volts with open arc, such as the flaming arc, and at from 65 volts to 85 volts with enclosed arc. Two flaming-arc lamps are used in series on 110-volt circuit. One might expect that four flaming arcs could be used in series on 220-volt circuits, but the difficulties of maintaining proper arc lengths increase much more rapidly than the number of arcs in series. The 220-volt incandescent lamps have always been inferior to the 110-volt lamps and are likely to continue under the double handicap of higher first cost and lower efficiency in operation. Tungsten lamps for 220-volt circuits consume 1.5 watts per candle, as against a consumption of from 1.15 to 1.33 for the 110-volt tungsten lamps. The 220-volt lamps, however, may be advantageous even to the ultimate consumer, who has to pay for the larger number of watts per candle. With the consumer it is likely to be a question as to whether he can have light at all if he is not supplied at 220 volts, for in many small and scattered towns the 220-volt system is the only electric system that would pay. He, therefore, has his choice, not be-

tween 110-volt and 220-volt lamps, but between 220-volt electric lamps and oil lamps.

Professor Shepardson, therefore, concluded that the 220-volt system is desirable in many cases where the loads are small and are scattered, and where the total load is comparatively small. As the country becomes more highly developed and as high-tension lines are multiplied, larger and larger districts are likely to be served from central stations generating alternating current and distributing energy over a radius of from 20 to 100 miles, as in Massachusetts. In the sparsely settled West it will probably be many decades before the large central stations will absorb or displace the alternating-current and 220-volt direct-current systems in the smaller towns.

In the discussion of this paper, Mr. J. R. Cravath questioned whether, as a commercial proposition, it would pay to install an electric lighting system in any town where the expense of an alternating current would not be justified; in other words, if the town is so small that a 220-volt system is required, it is a question whether any system should be built at all. Another commercial consideration is the possibility of connecting up the distribution system in the small town at some later date with a transmission system, supplying energy from a larger central station. If an alternating system is put in, it becomes a simple matter, in the event of such a transmission line being built into the town, to connect up the distribution system in the town to it. If the distribution in the town is 220-volt direct current, considerable money has to be expended in changing the system before supply can be obtained from the transmission line. The flickering of lamps due to fluctuation of voltage is more noticeable on a 220-volt lamp of a given candle-power than on a 110-volt lamp because of the smaller size of the filament and the consequently smaller heat inertia of the filament. This is demonstrated by the sensitiveness of the tungsten filament to fluctuations which is greater than that of carbon lamps.

Mr. Leonard Peterson reported having obtained good results with two 110-volt lamps on a 220-volt circuit. Recently, however, since the 220-volt tungstens came out, he had been using some of them with good results.

Mr. Sam Furst said that the 220-volt tungsten lamps have been giving good satisfaction wherever they have been used after once installed, but that the breaking in shipment and handling is considerably larger than on the 110-volt lamps. The success with the 220-volt lamps, however, is sufficient so that companies using 220-volt circuits no longer wire buildings for the use of 110-volt tungsten lamps.

VOLTAGE REGULATION AND ILLUMINATION.

In a paper read by Prof. L. B. Spinney, of Iowa State College, Ames, Ia., on regulation and illumination at the Iowa Electrical Association convention at Sioux City, April 21, he said that while every central-station manager will admit the desirability of good voltage regulation, it is much open to question whether its real importance is recognized by the majority of plant operators The subject is usually discussed from the standpoint of station efficiency and the life of the incandescent lamp. Tests from so-called 3.1-watt carbon lamps have shown that an increase of voltage of only 3 per cent reduces the commercial life of the lamp more than one-half, while an increase of 6 per cent reduces the life by more than two-thirds. It would seem that these considerations alone would be sufficient to illustrate the importance of good voltage regulation, but there is another and even more convincing argument, namely, its effect upon illumination. It was to this consideration especially that Professor Spinney's paper was directed.

A 2 per cent increase of voltage increases the candle-power 12 per cent, and a voltage 5 per cent in excess of normal increases the candle-power more than 31 per cent for a carbon-filament lamp. With the tungsten lamp this increase is not so much, but the effect is nevertheless large, even for a lamp of this type. The argument, therefore, may be applied regardless of the kind of lamp used. Professor Spinney, to illustrate the importance of this point, presented charts of voltage regulation obtained from four Iowa central stations. The voltage regulation curve given on these charts for plants C. D, F and J, Figs 1 to 4, were obtained by means of a portable voltmeter. The readings for each plant were taken without the knowledge of the plant operator, and at some distance from the central station. The average voltage at the point of readings was obtained and all variations were expressed in per cent of the average. The light line curve on the chart represents the voltage. The heavier curve represents the variation in candle-power above and below normal. This candle-power curve, which also represents the illumination curve, was calculated on the assumption that the lamps used were selected to operate normally at 3.1 watts per candle-power. The per cent variation in candle-power for each variation in voltage was obtained from one of the usual curves, showing the relation of candle-power to voltage for carbon-filament lamps. These curves show in a striking way to what extent the voltage fluctuations are magnified in the change in candle-power of the lamps.

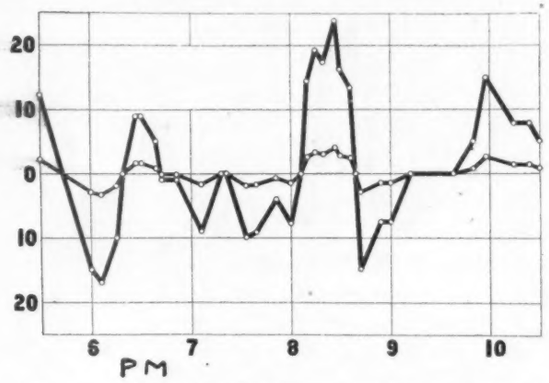


Fig. 1—Voltage and Candle-Power Fluctuation. Plant C.

The curves shown for the regulation of the four different plants are widely different in character, and suggest the different predominating causes of voltage fluctuations. Variation in switchboard voltage will affect the regulation at all points on the line. If there is insufficient copper in the line, there will be an excessive pressure drop on that line during its period of heavy load. The transformer regulation is always to be added to the line drop. The regulation at any given point in the system can never be better than at the switchboard, as far as downward fluctuations are concerned. As to upward fluctuations, line drop with increasing load may be compensated by raising the switchboard voltage.

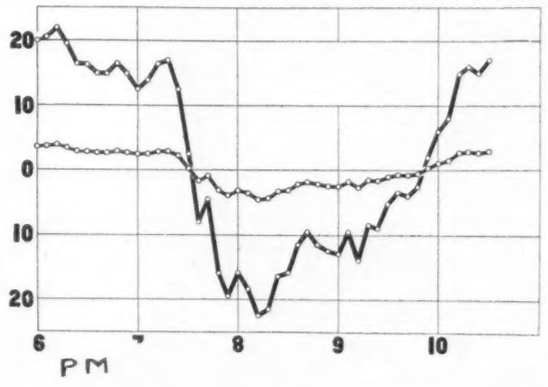


Fig. 2—Voltage and Candle-Power Fluctuation. Plant D.

The regulation curve of plant D indicates that the poor regulation is in this case almost entirely due to the line drop. The heavy load was carried by the line from 7:30 until 10

o'clock. The fact that the curve is smooth indicates that there was but little variation in the plant. The regulation curve of plant F indicates that the line effect was small and the variations merely those due to the efforts of the switchboard attendant to keep the station voltage constant. The curve for plant J shows a combination of the effects observed in plants D and F. The gradual depression of the curve from a value above the average at the beginning of the evening to a low

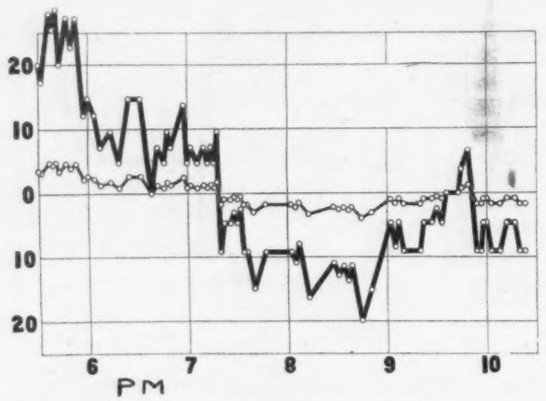


Fig. 3—Voltage and Candle-Power Fluctuation. Plant J.

value about 8:45, and its subsequent rise toward the initial value, points unmistakably to a line drop effect. The zigzag shape of the curve shows at intervals of a few moments; the switchboard voltage was adjusted with a view to keeping it constant. Evidently this curve would bear close resemblance to that of plant F had it been taken at the central station. The regulation curve of plant C is not so easy to analyze. It is evident that no line drop effect for this particular line is shown. At the same time the fluctuations are of such long period that they cannot be interpreted as showing a very high degree of watchfulness on the part of the switchboard attendant. If one were to hazard an opinion as to the meaning of the long periods of fluctuations of this curve, it might be suggested that the variations are such as would result from carelessness or lack of skill on the part of the man in the boiler-room, whose spasmodic or unskillful attention to duty resulted in half-hourly variations in steam pressure.

A discussion of these curves can hardly fail to call attention to the value of a voltage exploration of the network of lines, which radiate from the central station, for the purpose of determining the regulation on the various lines and centers of distribution. It is quite impossible to secure even reasonably good results by simply switchboard measurements and

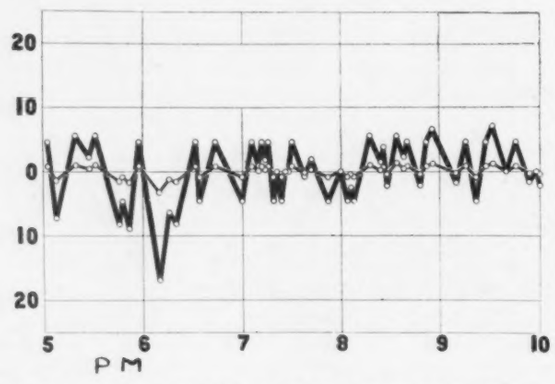


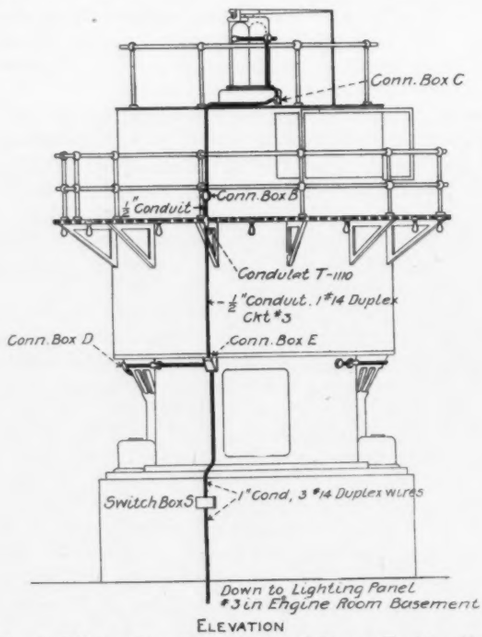
Fig. 4—Voltage and Candle-Power Fluctuation. Plant F.

adjustment. The first step toward improving the regulation of a plant is to make an exploration of the various lines with a voltmeter. The individual line effect should then be corrected by adding copper or by redistribution of line loads. Poor regulation, as has been repeatedly pointed out is the greatest cause of dissatisfaction among the users of electric light. The purpose of the curve shown is simply to give emphasis to the argument for good regulation.

A variation which expressed in volts may seem allowable is quite out of the question when given in terms of illumination. A customer may, for example, accept as satisfactory the assurance that the line voltage will not vary more than 5 per cent from the normal. It is hardly reasonable to suppose that he would accept with the same complacency the equivalent statement that his lamps would fluctuate from 12 cp to 20 cp, or that the illumination of the page as he sat before his reading lamp would vary from 1.5 ft-candles to 2.5 ft-candles. The illumination in plant J referred to ranged from 28.3 above to 19.9 below average, or a total range of more than 48 per cent. Again, in plant F, the illumination varied nearly 24 per cent.

WIRING OF TURBO-GENERATOR SETS.

In electric generating stations it is quite a problem to illuminate the generating machinery adequately with any system of lamps fastened to walls or suspended from ceilings. Such lamps are usually only serviceable for general illumination and inasmuch as the steam and electrical apparatus is usually painted black, the generator room of the average station does not present a very brilliant appearance at night even under very favorable circumstances. For this reason it is necessary to employ incandescent lamps attached to the machinery itself to illuminate such portions of the apparatus as require supervision and inspection from time to time. This is especially true of large turbo-generator sets which because of their size and build leave some of their parts in shadow with the very best system of general illumination known.


Conn. Box C
½" Conduit
Conn. Box B
Condulet T-1110
½" Conduit, 1#14 Duplex Ckt #3
Conn. Box D
Conn. Box E
Switch Box 5
1" Cond, 3 #14 Duplex Wires
Down to Lighting Panel #3 in Engine Room Basement

ELEVATION

Fig. 1—Wiring Circuits on Vertical Steam Turbine Unit.

In wiring turbo-generators it is necessary to use marine fittings and follow closely marine practice in running the circuits; because there is the possibility of the wires coming into intimate contact with condensation, steam and oil. Ordinarily No. 14 twin wire, flexible steel armored conductors are employed for this work; but where the conduit is attached to those parts of the machines which are rubbed down with cotton waste, rigid conduit is preferable because the waste is apt to catch in the flexible conduit and hanging cotton threads do not add to the appearance of the machine.

Illustrated herewith are a Curtis and a Parsons type of turbine, as installed and wired in the Waterside station of the

New York Edison Company. The feeder for the Curtis unit shown in Fig. 1 is brought from a lighting panel in the engine room basement in rigid conduit to three double-pole snap switches. The circuits pass thence in rigid conduit to a connection box just below the generator portion of the unit. From this box a circuit in rigid conduit feeds the lamps arranged about the turbine at this level and two special working receptacles for connecting lamps, etc., when desired in working on the unit. This row of lamps serves for the general illumination of the lower part of the turbine. From the connection box another circuit leads to the interior of the unit. The wiring here is in flexible armored cable and the lamps are arranged near the knees of the stool on which the generator rests. To this circuit are also connected the gage lamps, the lamp at the sight-feed lubricator on the oil line running to the lower bearing of the turbine and the lamp at the manifold for the return oil pipes from the bearings other than the step bearings. The two lamps over the steam and vacuum gages are fitted with reflectors as is also the lamp over the manifold for the oil pipes. The lamp for the sight feed lubricator is placed in a wire guard and back of the glass so that the oil flowing is silhouetted against the light and the turbine attendant can see at a glance whether the bearing is receiving oil or not. The same is true of the return pipes leading to the manifold. The reflector directs the light from the lamp into the manifold so that the return flow of oil is readily seen. The lamps on the interior of the unit serve to illuminate the parts of the unit below the generator and working receptacles are provided in the line for extension circuits. By means of the lamps the middle bearing carbon packing, and generator wind shield as well as the oil piping are visible and should trouble arise in any of these parts it can be quickly detected.

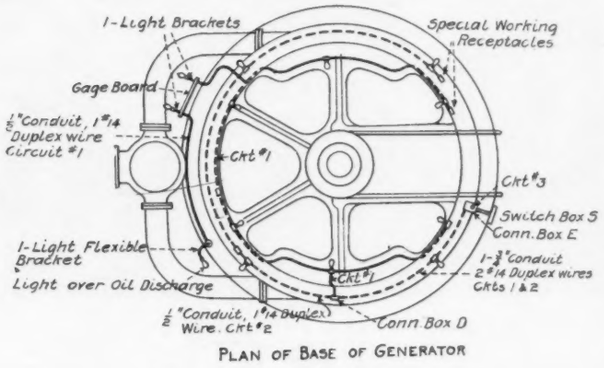


Fig. 2—Lamp Circuits near Base of Generator.

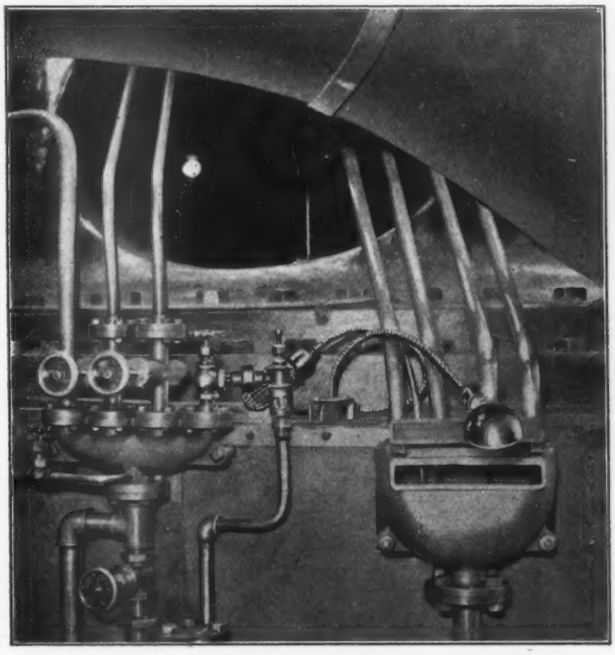


Fig. 4—Lamps at Sight Feed Lubricator and Manifold.

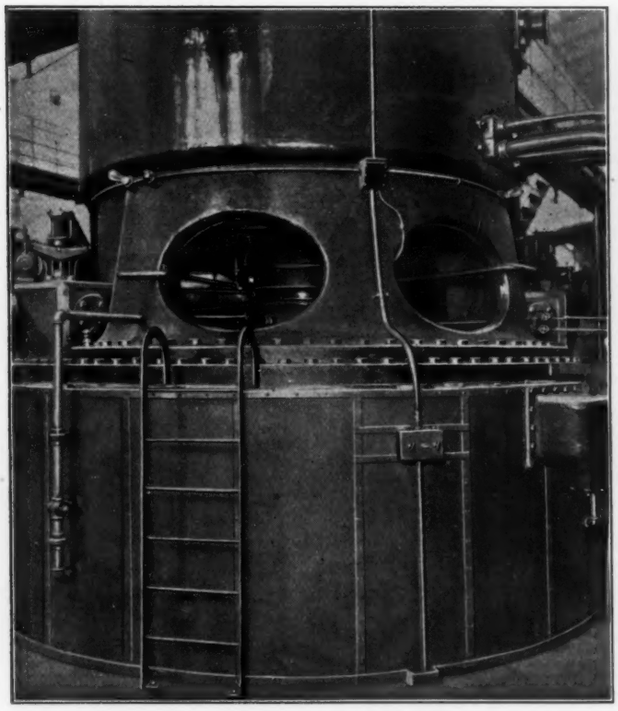


Fig. 3—Switches and Conduit Lines on Vertical Turbine.

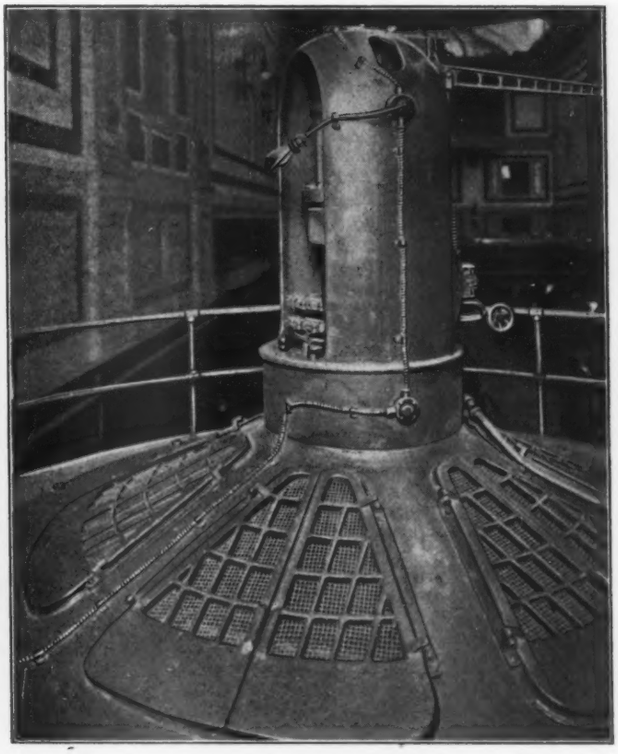


Fig. 5—Arrangement of Lamp Circuits on Governor of Vertical Turbine.

The remaining circuit leads to the upper platform of the turbine. Incandescent lamps fed through flexible armored cable are attached to the bottom of the platform between the brackets supporting the platform. An extension is run over the top of the unit from this line to a connection box at the base of the governor. From this box a circuit is run to two lamps fastened to flexible brackets which illuminate the governor and the synchronizing motor attachment. The lamps are provided with reflectors so that the governor mechanism is visible from the floor of the generator room. It is thus seen that three circuits suffice to light a 14,000-kw turbo-generator set. It is possible to employ 36 incandescent lamps on these circuits but less than that number of lamps provide ample illumination. Carbon-filament lamps are used throughout for obvious reasons.

The Parsons turbine is illustrated in Fig. 6. The unit is rather exceptional in that there are two generators, one a 60-cycle machine and the other a 25-cycle machine driven by the turbine. Ordinarily there is but one generator. The lamps on this unit are also arranged in three circuits. To the first circuit are attached all the lamps under the bearings and on both sides of the slip rings used for feeding direct-current to the field coils of the alternators. The lamps under the bearings permit temperature readings of the oil lines to be taken from time to time and any leaks in the pipes are seen immediately. Owing to the great number of bends in the circuit, it was found undesirable to employ rigid conduit on this part of the work which is run in flexible steel armored cable. The second circuit supplies energy to the pedestal lamp on the turbine, and the third circuit contains the lamps over the various gages and the governor. The half tone illustrations show clearly how these circuits are run so that further comment is unnecessary.

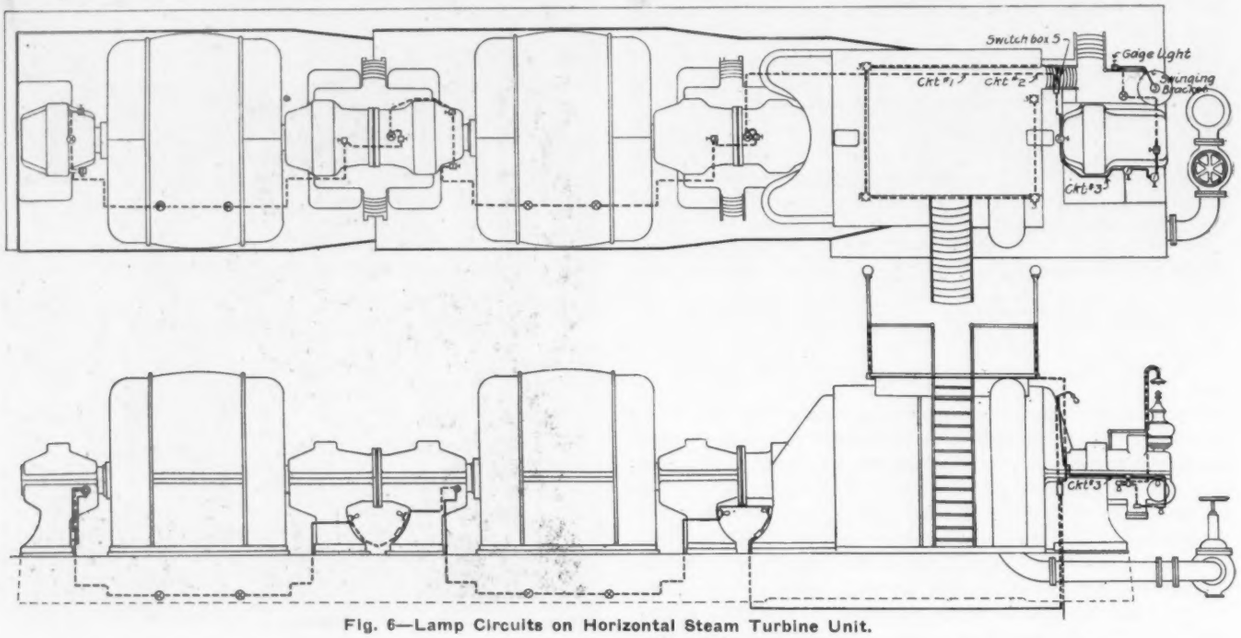


Fig. 6—Lamp Circuits on Horizontal Steam Turbine Unit.

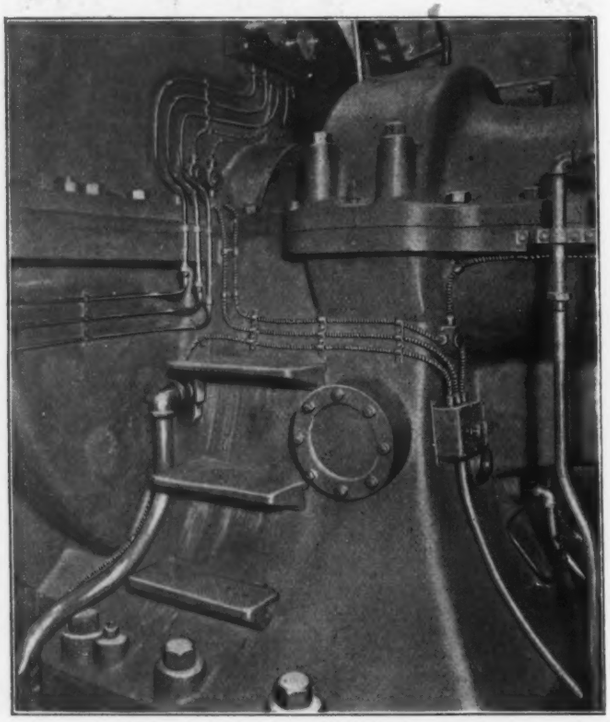


Fig. 7—Switches and Armored Cable Lines on Horizontal Turbine.

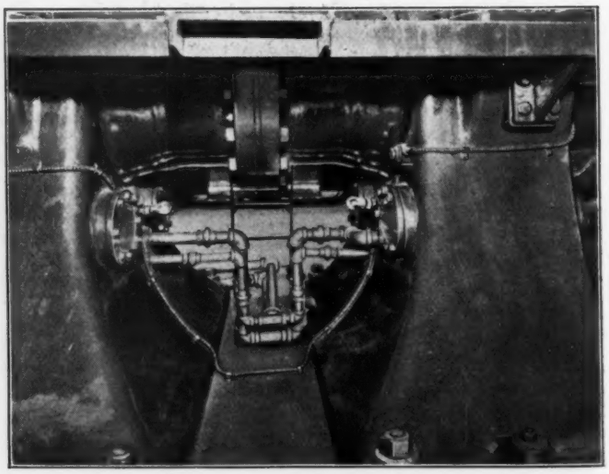


Fig. 8—Lamp Circuits Under Bearings of Horizontal Turbines.

The drilling and tapping of holes in the iron work for holding the straps with which the conduit is fastened down require much time, since in order to have the conduit follow closely the contour of the machines, straps are used about every foot or so. It is rarely necessary to drill large holes clear through the iron for the conduit or cable since with

the flexible twin wire armored cable it is easy to go around small obstructions without sacrificing appearances. With a little care the wireman can usually arrange his circuits so as to avoid the majority of obstructions.

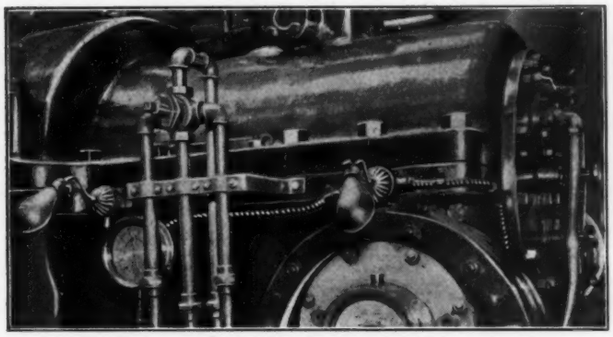


Fig. 9—Arrangement of Lamps at Gages.

LETTERS TO THE EDITOR.

The Small Consumer of Energy.

To the Editor of Electrical World:

SIR:—Few central-station companies, especially those operating in large cities, seem to be impressed with the importance or desirability of catering to the needs of the small consumer. Indeed, in many cities this individual is classed among the undesirables, and everything is done to discourage him from using electricity. In making rates, for instance, all the capital charges are foisted upon him, because he is of necessity a peak-load customer, and other consumers of energy whose load comes on during off-peak periods are given rates approximating the actual cost of making the electricity. The result is that a householder is charged oftentimes 10 times as much for the energy he consumes as a manufacturer.

It would seem that a company owed some reciprocal service to the citizens of a community to whom it is indebted for its franchises and privileges; and any system of rates which does not secure the just rights of both is open to question. Central stations were primarily intended for supplying electrical energy for lighting highways and residences. As such, they were operated only at night. When there was sufficient demand for energy during the day, 24-hour service became general; but despite this, the rate for residence service has not been reduced.

Now it is not claimed that one patron should not have a less rate than another, where differences in conditions affect the expense in performing the service; but where the difference in rates is disproportionate to the difference in conditions, certainly ground for complaint exists. In a great many cities the difference is so great as to produce an unjust discrimination, and this almost invariably against the small consumer.

New York City. MARTIN HALL.

Rational Central-Station Rates.

To the Editor of Electrical World:

SIR:—To the municipal ownership troubles, which confront many central stations, another disturbing situation is being added by the advocates of so-called scientific rates. In setting forth that one class of business is profitable and another unprofitable, they seem to forget that the man who buys the energy is the man to consider. What does he care whether his business pays the central station or not? Is it reasonable to believe, simply because there is a suave polished gentleman at the complaint window that he can mollify the concern which must pay, say, $20 a month whether they use electricity or not? "Educate him to our rates," said an engineer to the writer recently. Yes, and during the educational process a gas man walks in, takes the business and plays havoc with your scientific rate. "But his business wasn't profitable business anyway," says the scientific-rate man. But assuming that it wasn't, the result is that Jones tells Brown and Brown trots over to Smith, whose business may be profitable, with the story, so that when the unfortunate solicitor from the electric light plant tackles Smith, Smith tells him that he wouldn't consider electricity at any price.

The method of charging for energy used by one of the leading scientific advocates is of interest. His company operates in a city of 200,000 population supplying both gas and electricity. When a customer balks on the readiness-to-serve charge, the solicitor has ready a kw-hour contract to substitute; or if the prospect refuses to accept this, he is gladly secured on a flat-rate proposition.

In a town of 210,000 population situated in central New York, the central-station company controls both the gas and electric plants. It uses a scientific-rate system and publishes a very beautifully printed little volume explaining its rates, but which no one under the sun outside of central-station men can possibly understand. It added about 700 new electric customers to its lines in 1909, but may have added about 70,000 gas customers. The scientific rate works beautifully where the operating company controls both the gas and electric business.

In the two cities I have in mind, gasoline plants are the rule rather than the exception. Why is it necessary, you ask? The writer submits that a central station should be conducted by business men in a businesslike manner. There are plants operating throughout the country charging for their product on a kw-hour basis that are paying 6, 8 and 10 per cent. Ten to one there are fewer complaints of high bills for service, etc., coming into the complaint departments of these companies than in the cities where scientific rates are charged.

The public is not educated up to scientific rates. The educational process, as previously stated, is a long and a trying one. When Mr. Jones, for instance, drops into Mr. Smith's haberdashery to buy a tie, he buys one for a certain sum, depending on the quality of the tie. Ever since he started buying ties he bought them for so much apiece, or so much a dozen. For years men have been trading on that very simple basis.

Can the men who have invested money in central-station bonds afford to wait until the busy public has been taught the science of rate making? No; and just so long as there are internal combustion, or steam engines on the market, scientific rate-charging companies will have their troubles in preventing municipal agitation, and the men who never come in contact with the busy public, or who spend the day pushing the slide rule, will be to blame for every non-consumer.

Consider, for instance, a company which has been operating in a city for 25 years, say, on a kw-hour basis of charging. It is decided to use the readiness-to-serve method of charging. Solicitors must be sent out to advise the customers of the change. How many customers will be held whose monthly bills would be raised 20 per cent just because the company was losing money on their particular load? Yet in the aggregate the plant was paying 10 per cent on the investment. To reiterate, what does a customer care whether the company is losing money or not? "If you are losing money, why don't you sell out to the city?" says a municipal ownership man. "Losing money, eh!" says another fellow. "No; catch your company losing money." "I cannot understand what you are driving at," says a third. "I was thinking of putting in gas anyway. You pay for what you get then."

Central stations should be conducted on a businesslike basis. Let men take the helm who meet the public daily, who understand the public. The head of the steel trust is a lawyer. The heads of the greatest central stations in the country are either lawyers or business men. The head of the greatest gas company in the country is a lawyer, and he has made a success of the plant because he pursued businesslike methods. It is questionable whether these men, heads of these great corporations, who

charge on a straight-out basis for their product, would understand a scientific rate as laid down by some of our brilliant engineers, who are most certainly lacking in their conception of how much the public really will stand. Let men take the helm who can understand the likes and the dislikes of the busy public, who can listen to their complaints, and send them away with a smile. If a few pennies are saved monthly by different consumers on tungsten lamps, let them save. It is cheaper, gentlemen, than paying high-priced fakirs to go to Albany, or Springfield, or Sacramento, or Columbus, or Boston, or Hartford, to influence legislation. Bill the public for their electric current as they are billed for eggs, tripe, sardines or automobiles. They will know then; they will understand. Keep the engineers off. Put business men on. The latter can manage the sale of the product; others will make a failure of it.

Toronto, Canada. Eugene Creed.

[A business man who cannot, or will not, master the subject of central-station service costs, may be no more fitted to run a central station than a man of technical education who cannot, or will not, recognize that to meet success his methods must be adapted to the likes and dislikes of the public whose patronage is solicited. Moreover, it is doubtful if any public would really take a stand on the proposition that it should buy electric illumination as it buys groceries.—Ed.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Efficiency of Direct-Current Machines.—W. C. Clinton.—In Hopkinson's method of testing two similar machines the constant voltage in parallel with the armatures may either be applied directly to the generator terminals or directly to the motor terminals. In the former case the generator will be running at constant potential difference from no load to full load, while the motor voltage and the speed of the combination will be above their normal values. On the other hand, if constant voltage is applied to the motor terminals the motor voltage will be normal at all loads, and the generator voltage and the speed of the combination will gradually fall from no load to full load. This latter connection is a good one to use if it is desired to realize working conditions for the motor. To do this for the generator as a separately excited machine running at a constant speed and excitation, the contact A may be made at an intermediate point on the voltage V, as indicated in Fig. 1. There is one position for the contact A which will give constant

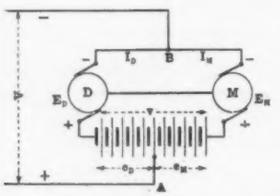


Fig. 1—Series Parallel Arrangement.

speed over the whole range of loading, provided that V is constant, and at the same time will insure that the drop of pressure at the generator terminal for a given current will be the same as that which would be observed for that current if the machine were on an actual resistance load. The nearest approach to identity of conditions of test for two similar coupled machines, when the whole of the power is supplied electrically, will be obtained by using the connections of the illustration and arranging things so that the relation

$$e_M - e_D = R\,(I_M - I_D) = iR$$

is fulfilled (where R is the resistance of the armature circuit of either machine). Usually iR is very small compared with e_M and e_D, especially at heavy loads, when i may become zero, or even reverse. It is, therefore, sufficient to make e_M equal to e_D. This is conveniently done by bridging V with two resistors of adjustable resistances in series and making the contact A at their junction, or using one resistor with a sliding contact, and making this the point A. The curves shown in Fig. 2 give the results of tests carried out on two similar shunt-wound interpole machines, each rated at 6 kw and 220 volts. The machines were directly coupled together and were supplied with separate excitation for their shunt windings. The excitations were kept exactly equal throughout the tests, the results of which are shown in curves 4 and 5 of Fig. 2, at a value that gave the normal speed as a motor running light. The machines were loaded for the parallel test (curve 6) by altering the field currents by an equal amount on either side of their initial equal values. Different loads for the series test (curve 7) were obtained by altering the generator field current and the applied voltage, the motor field current being kept constant. The efficiencies shown are for the rotating parts only, in all cases, the field circuit losses being left out of account. The efficiency

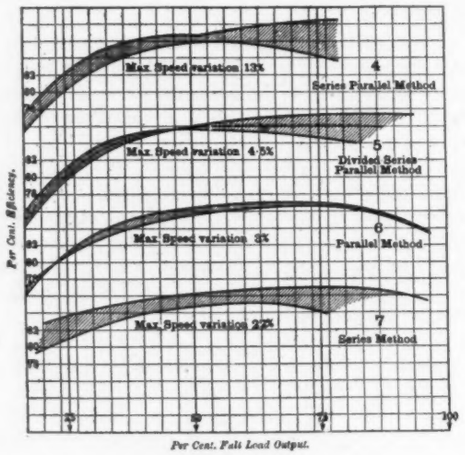


Fig. 2—Results of Tests.

curves of the machines, either as a generator or a motor, lie within the shaded areas. The mean value of the efficiencies at a given output by the divided series-parallel method should give the true efficiency of the rotating portion of either machine very nearly, as the only difference between them under the conditions of operation lies in their internal e.m.fs., the generator being as much below the normal voltage as the motor is above it. The dotted curve in curve 5 shows this result. The efficiency of the whole machine can then be ascertained by allowing for the known copper loss in the separately excited shunt winding.—Lond. *Electrician,* April 15.

Single-Phase Induction Motor.—J. H. Morecroft and M. Arendt.—The first part of a serial giving an elementary mathematical discussion of the single-phase induction motor. In the present installment the absence of starting torque and the development of the revolving field are discussed and the torque equations are given.—*Gen. Elec. Rev.,* May.

Automatic Regulation of Alternators.—M. Seidner.—A translation in abstract of his recent German article in which the author classifies and critically discusses the various automatic regulators for alternators.—Lond. *Electrician,* April 15.

Testing of Machines.—E. F. Collins.—In a continuation of his long illustrated serial on commercial electrical testing the author deals with rotary converters and synchronous motors.—*Gen. Elec. Rev.,* May.

Apparent Change of Ratio of Transformation in Three-Phase Transformers.—G. FACCIOLI.—In a certain case three single-phase transformers were installed to operate a rotary converter. The primaries of the three transformers were connected "Y," and the secondaries "Y" diametrical. The difference of potential between primary lines was 11,000 volts, and the normal e.m.f. of each secondary winding 210 volts. The three transformers were connected to the high-tension feeders (11,000 volts) and the voltage across each secondary winding was measured at no load. This e.m.f. proved to be 235 volts instead of 210. The leg e.m.f. corresponding to 11,000 volts "Y" is 6360 volts, and the ratio of the transformer windings was exactly 6360:210; therefore, there was no apparent reason for the higher secondary e.m.f. An investigation of the trouble disclosed the fact that the secondary e.m.f. was increased at no load from 210 volts to 235 volts by a triple frequency component of the voltage. The phenomena involved in the case are analyzed with the aid of diagrams.—*Gen. Elec. Rev.,* May.

Transformer Construction.—W. A. HALL.—A second article on the elements of transformer construction. After a general discussion of insulation, durability, reliability, efficiency and regulation, the author gives some notes on the construction of multiple transformers and then discusses series transformers. —*Gen. Elec. Rev.,* May.

Lamps and Lighting.

Three-Phase Arc Lamp with Four Electrodes.—A. RIGHI.—As early as 1904 Mercanton published an account of experiments with a three-phase arc lamp with three electrodes which was found to have a higher efficiency than a single-phase lamp. It has not come into use chiefly because the three electrodes do not burn off uniformly. The present author has obtained better results without any regulating mechanism by adding a fourth electrode which is not metallically in the circuit. In an ordinary single-phase differential arc lamp the lower electrode is replaced by three electrodes arranged vertically side by side and connected to the three leads of a three-phase system. Each has a diameter of 8 mm and they are placed at the corners of an equilateral triangle, the sides of which are from 12 mm to 15 mm long. The fourth upper electrode has a diameter of 20 mm and is placed in the center and is in general insulated. There are six craters, three on the upper electrode and one on each of the lower electrodes, the appearance of the arc being shown in Fig. 3. The light is uniformly thrown downward.

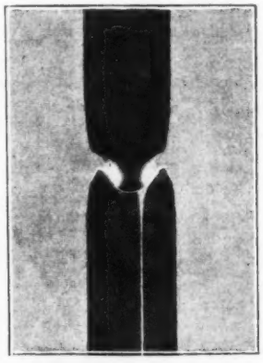


Fig. 3—Appearance of Arc.

The efficiency of the lamp has not yet been determined. The consumption of the upper electrode is stated to be very small. —*La Lumière Elec.,* April 9.

Double-Electrode Arc Lamp.—An illustrated description of the Abbey double-electrode arc lamp made in England. The new lamp, as will be seen from Fig. 4, has two pairs of electrodes, each pair being supported by copper cords passing over a drum. The feeding mechanism is the same as in the single-electrode lamp, each drum being attached to a large ratchet wheel with a double-toothed pawl controlled by the solenoids. The two pawls, which are rocked by means of a single pin, are so arranged that when the lamp first commences to feed only the pawl of the mechanism controlling the first pair of electrodes is affected, and consequently these electrodes are fed down until the holders reach the stops at the bottom. The lengthening of the arc after the last feed causes the shunt solenoid to lift the rocking lever further than before, with the result that the pawl of the second mechanism is brought into action. This causes the second pair of electrodes to descend and the arc is transferred to them. Feeding then proceeds as before. Though the shunt solenoid plunger is evidently working in a slightly different part of its travel when controlling the second mechanism, the voltage at which the arc burns is not different, owing to the fact that the friction against which the plunger has to work is different. In order that the tips of the second pair of electrodes shall not be covered with ash while the first pair are burning, the cast-iron "economizer" is constructed with two separate furnaces. The nature of the feed, which causes the electrodes to drop suddenly together and not to approach gradually as in lamps with clockwork mechanism, also insures the second pair of electrodes striking an arc in spite of a small deposit of insulating ash on their tips.—Lond. *Elec. Eng'ing,* April 14.

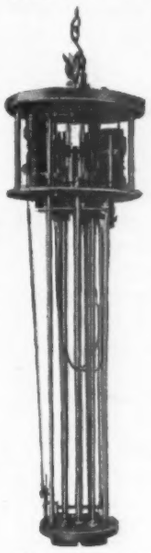


Fig. 4—Double Electrode Arc Lamp.

Metallic-Filament Lamp.—A note on a recent British patent (17,627, 1909; April 7, 1910) of H. Kuzel. Long filament loops are supported at three places, namely, at the extremities of the arms, at the bend of the loop, and in the middle by arms projecting from the stem to a greater distance than the end supports. The loop support is resilient, and puts such a tension on the filament that only those portions between the loop and the middle supports are prevented from sagging. The friction of the filament over the middle support prevents the tension from reaching the portions between the leading-in and middle supports, in order that the sag of these portions may be gradually reduced on burning, so as to compensate for the contraction of the filament.—Lond. *Elec. Eng'ing,* April 14.

Generation, Transmission and Distribution.

Water-Power Plant for Milan.—A new 60,000-hp installation utilizing a water-head of 1400 m (about 4600 ft.) of the Poglia River for the benefit of the city of Milan, was described by L. Zodel in a recent meeting of the Engineers' and Architects' Society of Zurich. The Poglia is a tributary of the Oglia River, and rises in the Adamello Mountains. The full head of 1400 m is utilized in two steps. There are, therefore, two stations, at Isola and Cedegolo respectively. The construction of the plant was commenced in 1907. The station at Isola is fed with water through a conduit, leading to a forebay, and a pipe system, which discharges into the turbines. The conduit has a length of 1500 m (1 mile) and is circular, 71 in. in diameter. Of the four pipe conduits projected two are now completed. The pipes begin with a diameter of 800 mm (31.5 in.) and a wall thickness of 7 mm (0.28 in.); in the lower portion the diameter is diminished to 750 mm and 600 mm, and the thickness increases to 32 mm (1.26 in.). The upper portion of the pipes is riveted, and the lower portion is lap-welded by the aid of water-gas. The whole system is buried 8 ft. deep to prevent freezing. Seven generators, each rated at 7000 hp, fitted with 500-hp exciters, are projected; four of these units are now being installed. The whole hydraulic part of the plant—pipes and turbines—is being furnished by Escher Wyss & Company and Professor Prasil has designed a new regulation system for the turbines in order to meet the pressure fluctuations. The energy generated is transmitted at 12,000 volts to the lower station at Cedegolo. This station is fed both by the discharged water from Isola and by independent sources, and as there was no suitable space for a collecting basin of the reservoir and dam type on the precipitous rocks, the basin was planned as a cellular structure in ferro-concrete, consisting of 140 cells arranged in three tiers above one another. This part of the

project was carried out within a hundred days. From the basin two pipes, each 40 in. in diameter, lead down to Cedegolo, where five units, each rated at 4500 hp, have been put up. The general switchboards and transformers are at Cedegolo, while the Isola power station is very simple. The energy to be supplied to Milan will be transmitted at 72,000 volts by an overhead line, 75 miles in length. When this scheme is completed Milan will receive a total of 320,000 hp from hydroelectric plants.—Lond. *Engineering*, April 15.

Traction.

Electric Traction on Bavarian State Railways.—The first part of an abstract of a recent report of B. Gleichmann on the project of electrifying the State railways of Bavaria, electric energy to be derived from waterfalls. In the present installment the author begins to calculate the amount of power required. In calculating this power he makes certain novel assumptions which simplify the calculations.—*Elek. Zeit.*, April 14.

Electric Automobiles.—H. S. Baldwin.—An illustrated article on the motive equipment of electric automobiles, with high-speed single-motor drive.—*Gen. Elec. Rev.*, May.

Installations, Systems and Appliances.

Submarine Boats.—J. Breguet.—The first part of an article on the electric equipment of the new submarine boats of the French Navy, dealing especially with the speed variation of direct-current motors.—*La Lumière Elec.*, April 9.

Fans.—An article describing various fans of English make and also a system of ventilation combining a fan with an ozonizer by which ozonized air is continuously driven into the room.—Lond. *Elec. Eng'ing*, April 14.

Wires, Wiring and Conduits.

Transmission Line Calculations.—W. E. Miller.—A paper giving the formulas, constants and hyperbolic functions for the solution of transmission line problems. Two numerical examples are shown.—Supplement to *Gen. Elec. Rev.*, May.

Aluminum Joints.—Descriptive notes on jointing aluminum busbars, machine and feeder connections. Aluminum rod for machine connections or feeder connections in switchboard work can be jointed by butt-welding on site with a blowpipe. In inaccessible places, screwed couplings are suitable. Heavy busbars are constructed of aluminum bars, clamped together with spacing pieces between the individual bars.—Lond. *Elec. Eng'ing*, April 14.

Copper.—L. Odendall.—The conclusion of his long article on the production of copper in the United States. The author discusses the production of copper in Montana and Utah, electrolytic refining, the probable future and the probability of a copper trust.—*Elek. Zeit.*, April 14.

Cables.—W. E. Hazeltine.—An article giving general considerations on cables for underground electric distribution.—*Gen. Elec. Rev.*, May.

Electrophysics and Magnetism.

Iron Losses for Rotating Magnetism.—J. Herrmann.—By measurement of the iron losses in rotating fields and in single-phase alternating fields the author has shown that for magnetic inductions between 2000 and 12,000 lines of force per square centimeter there is no essential difference between rotating and alternating change of magnetism. On the other hand, other authors have found that for high saturations the matter is different; in this case the iron losses increase continually with increasing saturation in an alternating field up to the highest saturation, while with revolving magnetic fields the loss curve increases to a maximum and then decreases and finally tends to decrease to zero. The present author doubts this result and then describes experiments of his own from which he concludes that in rotating fields the losses continually increase so that there is no essential difference between alternating and rotating magnetism in this respect.—*Elek. Zeit.*, April 14.

Effect of Pressure and Temperature on the Mobility of Ions.—A. F. Kovarik.—An account of an experimental investigation on the effect of changes in the pressure and temperature of gases upon the mobility of the negative ions produced by ultra-violet light. With changing pressure the mobility of the ions, in both dry air and dry carbon dioxide, varies inversely with the pressure from 760 mm down to about 200 mm, so that the product of the mobility by the pressure is constant. In dry air below 200 mm the product of the mobility by the pressure increases as the pressure is reduced, the increase being slow at first, but very sudden at about 100 mm, so that at 8.8 mm the product was found to be 10 times as great as that at atmospheric pressure. This result indicates that below 200 mm the size of the ion is increasingly smaller as the pressure is reduced. In dry carbon dioxide below 200 mm there is likewise a sudden increase in the product of the mobility by the pressure, but this occurs at a somewhat higher pressure than in air.—*Phys. Rev.*, April.

Electrostatic Effect of a Changing Magnetic Field.—J. M. Kuehne.—An account of a carefully made experiment which, within the limits of experimental error, shows that a charged body in a field swept by magnetic lines of force, is subjected to a mechanical force, the magnitude and direction of which are in agreement with that demanded by the electromagnetic theory of Maxwell.—*Phil. Mag.*, April.

Thermo-Electric Currents.—C. H. Lees.—B. J. Thomas has recently pronounced some laws on the relation between the thermo-electric properties of a metal and its conductivity for heat and for electricity. The present author shows that the experimental data in support of these laws are insufficient and that as a matter of fact do not support the laws at all.—*Phil. Mag.*, April.

Electrochemistry and Batteries.

Electric Furnaces in Non-Ferrous Metallurgy.—J. W. Richards.—The author discusses the various applications which the electric furnace may find in the treatment of metals other than iron. He first discusses the melting of the metals for refining and casting and the melting together of metals to form alloys. For both purposes the electric furnace offers many advantages. As to the roasting of sulphide and arsenide ores electrical energy could be used only for yielding that supplementary heat above the heat value in the ore itself; in this case the application of electrical energy depends entirely on its cost. The author then discusses the possibilities of the use of the electric furnace in the concentrating and smelting of raw or partly roasted ores to matte and in the reducing smelting of raw or roasted ores to metal. With respect to the latter object the author is confident that there are localities where conditions already exist which would make the electric shaft furnace smelting preferable to the converter methods of non-ferrous metallurgy. He finally discusses the use of the electric furnace in zinc metallurgy, in which case the electric furnace, if practicable, would be far more efficient than the present retort furnace.—*Met. and Chem. Eng'ing*, May.

Electric Nickel Smelting.—An illustrated description of a new electric furnace plant in the South producing nickel silicide by reduction from ore in an electric furnace in a single operation.—*Met. and Chem. Eng'ing*, May.

Output and Efficiency of Electric Furnaces.—C. Hering.—An article on the possibility of improving the output and efficiency of an existing electric furnace by some changes in the electrodes. Either the material of the electrode may be changed or changes may be made in the dimensions. To the discussion of the general principles a numerical example is added.—*Met. and Chem. Eng'ing*, May.

Calcium Carbide.—M. deKay Thompson.—The first part of an investigation of the equilibrium of the system consisting of lime, carbon, calcium carbide and carbon monoxide.—*Met. and Chem. Eng'ing*, May.

Chemical Reactions at Electrodes.—R. Stevenson.—The author discusses systematically the different chemical reactions which may go on at an electrode according to whether the discharged ion reacts with itself, dissolves in the electrode, reacts with the electrode, dissolves in the solution, reacts with the solvent or solute, or with suspended particles or with dissimilar ions of similar charge, or whether discharged ions of

dissimilar charge act with each other, etc. Examples of the different cases are given, and finally the effect of temperature, pressure, concentration and nature of electrolyte, current density, diffusion, light, e.m.f., nature and concentration of electrodes, and catalytic action are concisely discussed.—*Met. and Chem. Eng'ing,* May.

Commercial Electro-Analysis.—A. P. FORD.—A communication on rapid electro-analysis of brass in a commercial laboratory. The use of revolving electrodes is thought to be too cumbersome, but Stoddard's method using stationary electrodes and a wire gauze cathode has been found practicable, although more time should be allowed than stated by the original author. —*Met. and Chem. Eng'ing,* May.

Units, Measurements and Instruments.

Electrochemical Equivalent of Silver.—F. LAPORTE AND P. DE LA GORCE.—An English translation of their recent French Academy paper. The results of the last three researches obtained in three different governmental institutions were as follows:

British National Physical Laboratory	1.11827 mgm. per coulomb.
German Reichsanstalt	1.11818 "
French Laboratoire Central	1.11863 "

By improving the methods of purification of silver nitrate the Laboratoire Central of Paris has now brought its own figure into better agreement with those of the Reichsanstalt and the National Laboratory. The general mean of the Laboratoire Central results is now 1.11829.—Lond. *Electrician,* April 15.

Gas Thermometry.—A. L. DAY.—A summary of his researches of a long series of years on high-temperature gas thermometry and its present limitations. The latter are discussed under the following headings: The gas, the bulb, the furnace, the manometer, and the auxiliary thermo-element. Formerly the realm of gas thermometry ended with 1100 deg. C. It has now been extended up to 1550 deg. C. The standard melting points determined by the author are given in the following table and for comparison the figures of the Reichsanstalt are added in degrees Centigrade.

Substance	Point	Atmosphere	Crucible	Temperature	The Reichsanstalt Scale
Zinc	Melting and freezing	Air	Graphite	418.2° ±0.3	419.0°
Antimony	Do.	Carbon monoxide.	Do.	629.2 ±0.5	630.6
Silver	Do.	Do.	Do.	960.0 ±0.7	961.5
Gold	Do.	Do.	Do.	1062.4 ±0.8	1064.0
Copper	Do.	Do.	Do.	1082.6 ±0.8	1084.1
Diopside (pure)	Melting	Air	Platinum	1391.2 ±1.5	
Nickel	Melting and freezing	Hydrogen and Nitrogen	Magnesia and Magnesium Aluminate	1452.3 ±2.0	
Cobalt	Do.	Do.	Magnesia	1489.8 ±2.0	
Palladium	Do.	Air	Pure Magnesia	1549.2 ±2.0	1575.2
Anorthite (pure)	Melting	Do.	Platinum	1549.5 ±2.0	

In addition, the following temperatures were incidentally obtained:

Cadmium	Melting and freezing	Air	Graphite	320.0 ±0.3	321.7
Aluminum	Freezing	Carbon monoxide.	Do.	658.0 ±0.6	657.
Platinum	Melting	Air	.....	1755.	

—*Met. and Chem. Eng'ing,* May.

Motor Meters.—P. MAY.—The author gives the results of his experience with watt-hour meters of the Thomson type and of an investigation of the causes of sparking at the commutator and brushes, with a resulting wear and tear of the meter, which proves a source of error. The best construction of the brushes is then discussed and means are given by which central stations are enabled to keep their meters longer in use than is now possible. Since it is a fact that meters with injured brushes and rough commutators show serious errors only below one-fifth full load, while the errors are small at one-half load, and practically zero at full load, the author thinks that any correction at low loads would be of greatest advantage for the useful life of the meters. Means of that kind have not yet been developed for meters of the Thomson type, but for magnet-motor meters such an arrangement has been introduced with great success in the last years. In magnet motor meters the brushes are arranged to be movable, and according to the load they are more or less displaced on the commutator by an electromagnet coil. The author thinks that the same simple and inexpensive device could be used to great advantage for Thomson meters. —*Elek. Zeit.,* April 14.

Measuring Mutual Induction.—A. CAMPBELL.—His recent (British) Physical Society paper in full on the use of mutual inductometers. The author describes a modified mutual inductance bridge, discusses the measurement of effective inductances, the use of the mutual inductometer for the null method for magnetic tests of iron, and tests of current transformers.—*Phil. Mag.,* April.

Testing Set.—An illustrated description of a new testing set installed at the School of Technology at Manchester for testing meters and for experimental work. It consists of three machines rigidly coupled together on a combined bedplate. It is driven by a 13-hp, direct-current, shunt-wound motor, suitable for operating on a 400-volt circuit. This motor is of the variable-speed type, and capable of running between speeds of from 500 r.p.m. to 1700 r.p.m., giving its rated output through this range. Two generators of the revolving armature type are arranged one on each side of the motor. These have ratings of 1 kw and 5 kw respectively, three-phase, 25 cycles to 85 cycles, 100 volts to 340 volts. Each machine is designed to give a sine wave, and is fitted with six slip rings. The motor is fitted with a terminal board arranged for connecting the field coils in parallel, as they may occasionally have to be excited at a lower e.m.f. than 400 volts. The 1-kw generator has its yoke machined on the outside and fitted into a circular seat on the bedplate, and is arranged with a worm gear for rotating the field. This enables the machine to be given a displacement of as much as 200 electrical degrees with respect to the 5-kw generator. A gradual variation of phase adjustment is obtainable by this means while the set is running. This is necessary, as the phase has to be adjusted for each variation in current output on account of the varying lag with a varying current in the armature. By this arrangement it is possible to vary from the maximum lagging to the maximum leading current.—Lond. *Electrician,* April 15.

Testing Laboratory.—C. H. SHARP.—A long and fully illustrated description of the Electrical Testing Laboratories of New York, their purpose and equipment, with special reference to electrochemistry.—*Met. and Chem. Eng'ing,* May.

Telegraphy, Telephony and Signals.

Coherers.—W. H. ECCLES.—An abstract of a (Brit.) Physical Society paper on the relations between the energy given to the detector in the form of electrical vibrations and the energy delivered by the detector, as direct current, to the circuit of the indicating instrument. The author describes also experiments on coherers made of oxidized iron wire dipping into mercury, and on coherers made of a clean iron point touching an oxidized iron plate.—Lond. *Electrician,* April 1.

Automatic Signals for Railways.—C. P. NACHOD.—An illustrated paper giving a brief review of the general field of electric railway signaling, together with a fuller description of a particular type of contact system.—*Jour. Franklin Inst.,* April.

Signals for Mines.—An illustrated description of an electric system of signals for the winding plant in a mine.—Lond. *Elec. Eng'ing,* April 7.

Miscellaneous.

Physiological Effects of an Alternating Magnetic Field.—S. P. THOMPSON.—While heretofore physiological effects of magnetism have not been discovered the author has established one by constructing a solenoid sufficiently large to admit an observer's head, the winding being traversed by an alternating current. This current is sufficient to produce a virtual field of about 1000 c.g.s. units at the center of the coil, or a maximum instantaneous value of 1400 c.g.s. units. On inserting the head into the interior of the coil there is a marked effect, a faint flickering illumination being perceived over the whole region of vision.—Lond. *Electrician,* April 15.

New Apparatus and Appliances

ELECTRIFYING THE PULLMAN SHOPS.

Accompanying other important improvements and extensions, the Pullman Company is now engaged in the important and interesting task of equipping its entire manufacturing establishment at Pullman, in the southern part of Chicago, for electric drive. As is, of course, well known, Pullman is a great center for the manufacture of sleeping cars and other railways cars, and about 10,000 men are employed. The works consist of a large number of buildings, and among the plant extensions are two steel passenger-car shops, each 220 ft. wide and 420 ft. long. These shops, just completed, have increased the capacity of the company to turn out passenger cars about two-thirds, making the total capacity about 150 cars a month. In addition, an independent steel freight-car plant has been erected north of 103d Street and about a mile from the remainder of the works. This plant consists of a main building 400 ft. x 1175 ft., and two other buildings, one a wheel and axle shop and the other a mechanical building, including a power plant for the steel freight-car department and a machine shop. This steel freight-car department is entirely new throughout and will be operated very largely by electric motors from the beginning.

This "general" power house will supply energy to motors having a rating of about 3000 hp and used for driving the machinery in the various metal-working, wood-working and other operations in the manufacture of cars, as well as blowers, cranes and the various power apparatus used in a large manufacturing establishment. It will replace several existing steam-engine units, and it is of particular interest to note that among these is the 1400 hp Corliss engine which was exhibited at the Centennial Exhibition of 1876, and which was at that time the largest steam engine in existence. It is not known at present what disposition will be made of this interesting historical exhibit.

The ultimate equipment of the "general" power house will consist of three 1500-kw horizontal Allis-Chalmers turbo-generators, the output being three-phase, 60-cycle current at 2200 volts. In addition the plant will contain four 4000 cu. ft. air compressors. The initial installation consists of two of the generating units and three of the compressors. This power house is built about 200 ft. from the existing boiler house of the works, equipped with eight 400-hp Stirling boilers and having room for 14 boilers of the same size. Steam will be obtained from this existing boiler plant by means of an underground tunnel connection leading to the power house.

There will be at first two exciter units in the general power house, each of sufficient capacity for two of the main generators. The dynamos of these equipments will be of 60 kw each, and one will be steam driven and one driven by a 60-kw, 2200-volt induction motor. When the third generating unit is installed another electrically driven exciter set will also be placed in position.

For supplying direct current to crane motors and a few other direct-current motors, a motor-generator set has been placed in the "general" plant. This consists of a 300-kw, 220-volt, direct-current generator driven by a synchronous motor.

The switchboard of this general power house is a handsome one of Italian marble and is under construction by the Delta Star Electric Company. The board consists of three generator panels, five exciter panels, six motor-generator panels, one Tirrill regulator panel, one station-lighting panel, about 20 feeder panels for both alternating current and direct current, and one blank panel which will be used ultimately to control the tie line to connect the "general" power house with the steel freight-car works power house. The alternating-current switches are electrically operated and are placed in a switch-room under the switchboard, which is on the engine-room floor. The basement also contains the condensers and steam auxiliaries, as well as a 4,000,000-gal. steam pump used for supplying water to the premises.

At various accessible points about the works are placed transformer pits where the electricity from the power house transmitted underground at the generator voltage of 2200 is reduced to 440 volts for motors and 110 volts for lighting. The electric lighting of the shop is accomplished by flaming arcs for exterior illumination and for large interiors, supplemented by carbon and tungsten incandescent lamps. Electric motors, having an aggregate rating of about 3000 hp, will be scattered through the various shops in this group to drive various classes of machinery. Both individual and group drive will be used. The motors will range from 5 hp to 75 hp each, and possibly there will be about 100 of them. The contract for the motors has not been let, however.

Returning now to the power plant at the new steel freight-car works, it is to be noted that while somewhat smaller than the "general" power house, it is still a large and important installation. Here there will be three air compressors of the same size as in the "general" plant, and there will be three 1000-kw Westinghouse horizontal turbo-generators, each producing 440-volt, alternating three-phase, 60-cycle current. There will be two 500-kw motor-generator sets, while the arrangement of exciters will be practically the same as that in the other power house. Electricity from this plant will be transformed down to 110 volts for lighting service, but will be used at generator voltage for the motors. The proportion of direct-current load is larger here than in the "general" plant, there being 13 or 14 cranes in the main building operated by 220-volt series motors. It is to be noted that there is a larger proportion of individual motors in the steel freight-car works also, than in other departments of the Pullman establishment. One interesting feature of the power plant here is a 250-hp Corliss compound condensing steam pump delivering water at 1000-lb. pressure through steel pipe laid in tunnels, and into the main building for operating hydraulic presses. This pipe line, perhaps 1500 ft. long, is fitted with shock absorbers and a hydraulic accumulator.

The Pullman Company is itself designing, installing and operating these large electric installations. The work is done through the mechanical department, of which Mr. T. Dunbar is manager.

MOTOR-DRIVEN MINE HOISTS.

The single and double-drum electric motor-driven mine hoists shown in the accompanying illustrations are especially designed for mines, quarries, planes, shafts, etc. They are made by the S. Flory Manufacturing Company, Bangor, Pa., and are equipped with the Werner patent band friction and driven by Westinghouse motors. The patent band friction is actuated through different members—the gear, drum, rocker shafts and strap bands. After the frictions are thrown into contact they will positively remain in this position until released. The drum and gear form a unit and can be operated as a reverse motion hoist without producing any end strain on the bearings, the value of which is obvious. When the frictions are thrown out of contact, the drums are loose on the shaft and will revolve free at high speed when lowering or paying out the rope.

The single-drum hoist is shown with a Westinghouse electric railway air compressor and air reservoir mounted on the base of the hoist. The reservoir is connected to the air cylinder at the end of the drum shaft. The air valves are actuated by a lever, shown close to the battery of two levers and controller. Very little exertion is required by the motorman to throw the friction in and out of contact as it is of the toggle type. After the air compressor is put on the contact continues until the friction is reversed by the reverse motion.

The single-drum hoist shown was installed at the Bliss Colliery of the D., L. & W. Company. The drum is 60 in. in diameter, 48 in. long between the flanges, and is designed for an 8000-lb. rope strain at a speed of 500 ft. per minute. The hoist is operated by a Westinghouse 150-hp alternating-current motor, which type of induction motor is especially suited for application

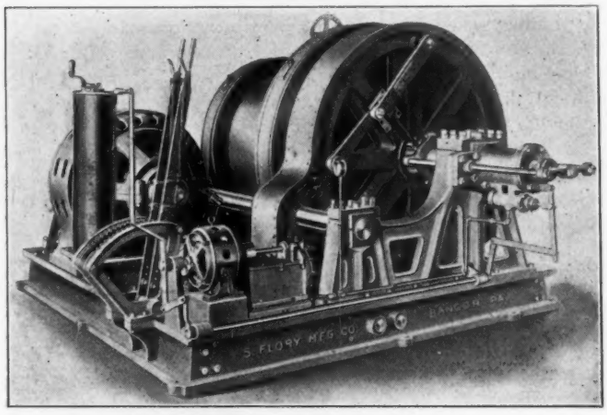


Fig. 1—Single Drum Mine Hoist.

where a strong starting effort is needed, and is well adapted for use on circuits carrying lighting loads, as the starting of it does not appreciably affect the voltage regulation. These motors are controlled by standard Westinghouse single-handle, reversing drum-type controllers which insert resistance in the secondary at starting and gradually cut it out as the hoist speeds

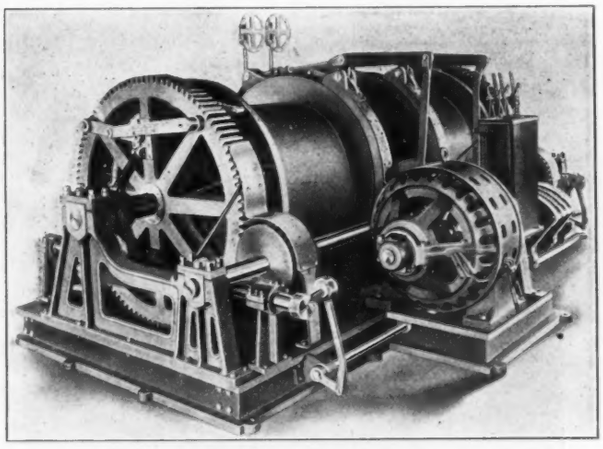


Fig. 2—Double Drum Mine Hoist.

up; the controller has a large number of points that give smooth acceleration. When the controller is in the off position, the motor is entirely disconnected from the line.

The double-drum hoist shown was installed for the Bessemer Coal, Iron & Land Company, Messins, Ala. It is connected to a Westinghouse 125-hp motor of the same type.

NOVEL TYPE OF METER PANEL.

Distribution and metering panels of novel and compact design are to be installed in the new Harris Trust & Savings Bank Building now being erected in Chicago. In these panels use is made of the distribution busbars themselves as fuse-plug holders, employing the removable fuse plugs to take the place of the usual permanent connectors and thus rendering the panel connections extremely flexible. A similar arrangement is admirably adapted for making the metering connections.

Fig. 1 shows a sectional elevation of the bus construction for the simplest case of fusing to the consumption circuits. A heavy cast-copper busbar of sufficient thickness to insure rigidity and wide enough to take the standard Edison screw plug has its six holes bored and tapped to the standard Edison base thread. Beneath the centers of these holes, when the bus is in position, are fixed tall contact nuts held by through bolts which traverse the panel slab. To complete the connection it

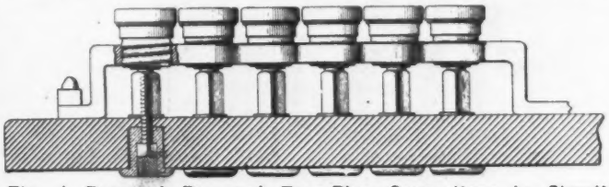


Fig. 1—Recessed Bus and Fuse-Plug Connections to Circuit Distributing Buses.

is thus necessary only to screw the fuse plugs into place in the recessed busbars, seating them securely on the tops of the nuts which are connected to the respective circuits, and are of the proper height to make contact with the plugs.

In the case of the connecting plugs on the metered side of the lines it is evident that precisely the same arrangement might not be quite satisfactory, as the plugs could be shifted at will by any person having access to the panels, while in replacing blown fuse plugs errors might be made in putting the new plug in place, in either instance impairing the proper meter connections. For the metered lines the construction shown in Fig. 2 is, therefore, used, employing the same recessed and threaded busbar as before, but making use of a fuse holder which is externally threaded to fit in one of the busbar sockets and internally threaded to receive the fuse plug. When inserted in its proper position on the busbar this fuse holder receptacle can be locked into place by a set-screw, making it secure against unauthorized tampering.

Screwing the fuse plug into place in the holder depresses the central contact plunger, which bears on the transverse meter busbars mounted flat on the slab beneath. The distance between the threaded upper bus and the meter busbar is such, of course, that it cannot be bridged by the standard Edison base. Thus no plug other than the authorized fuse holder, which may be fastened in place, can be used for making the connection. While fuses can be removed and replaced by hand, a special screwdriver is required in order to change any meter connections, when the locking set-screw is in place. This type of panel also makes it impossible to conceal the arrangement of any meter connection. The recessed busbars are back-connected, as indicated, a novel form of connection with the line wires being provided, as shown in the sketch in Fig. 2. To change the metering connection of any circuit it is only necessary to insert the fuse-holder meter plug at the point of intersection of the desired service and meter buses.

An arrangement of a 24-circuit panel equipped with eight connected meters is shown in Fig. 3. Provision is made, however, for a total of 24 meters by an ingenious arrangement of sectionalizing the vertical buses into various lengths. This

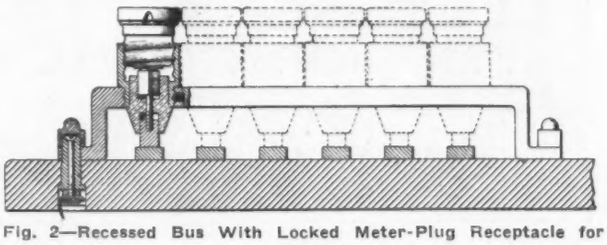


Fig. 2—Recessed Bus With Locked Meter-Plug Receptacle for Fuse.

sketch shows the first four lines leaving the upper left-hand corner of the panel (Rooms 51, 52, 53 and 54) metered from the second meter bus, while the next two (Rooms 55 and 56) are metered from the fifth bus, and so on throughout the panel. The other sides of the various lines are fused through the simple fuse plugs, without holders, mounted in the main neu-

tral buses at the top of the panel, as in the case of an ordinary distributing panel. As an example of the compactness to which this type of construction lends itself, a 16-circuit distribution can be placed on a panel board 8 in. x 10 in., without allowing for the main-line fuses. These panels are said to occupy the smallest amount of space of any approved by the underwriters. The construction is substantial and permits

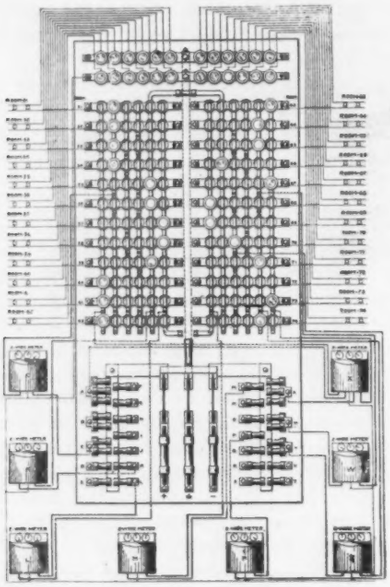


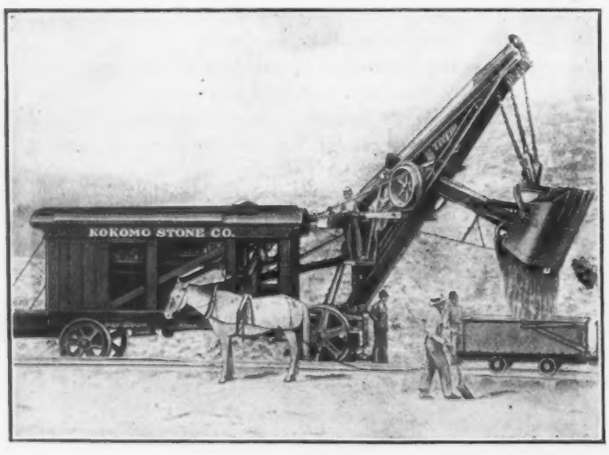
Fig. 3—Recessed-Bus Construction Applied to 24-Circuit Meter Panel.

all changes to be made with the minimum of effort. Patents covering this type of distribution and metering panel construction are held by the inventor, Mr. Arthur C. McWilliams, of Chicago.

The panel is to be marketed by the J. Lang Electric Company, Chicago.

ELECTRIC SHOVEL.

Where electric power is available, an electric shovel offers many advantages over a steam shovel, chief among which is the elimination of the boiler, the most annoying part of a



Electric Shovel.

steam-shovel outfit. Again, a steam shovel wastes considerable fuel and water at night, especially in winter, as the fire must be kept up to prevent the boiler and pipes from freezing. Furthermore, on an electric shovel, the power is always ready, easily applied, and is not being consumed when the shovel is idle waiting for cars or from any other cause. As soon as the power is cut off from the motors, the consumption of current stops; hence, there is no waste of current whatever. The electric shovel should appeal strongly to brick and tile manufacturers, to owners of stone quarries, cement plant, electric railroads, placer gold mines, and ore mines that are being operated by what is known as the "open cut" method, as a battery of electric shovels operated from a central power plant will affect an enormous saving over steam shovels.

The shovel shown by the photograph is of the "Little Giant" type, mounted on cast-steel traction wheels. It carries a 1¼-cu.-yd. dipper and weighs approximately 35 tons. It will make a cut 40 ft. wide in a 10-ft. bank and will clear a floor of 26 ft. The point of the crane stands 20 ft. above the ground. The dipper will dump 12 ft. 6 in. above the ground and 21 ft. out either way from the center of the shovel. The car body is 23 ft. long by 7 ft. wide.

The shovel is equipped with three Westinghouse motors, as follows: One 60-hp motor for hoisting the dipper, one 30-hp motor for swinging the crane, and a 30-hp motor on the crane for crowding the dipper into the bank. All the motors are for 60-cycle, two-phase, 220-volt, alternating current. The shovel has a capacity of from 600 cu. yd. to 800 cu. yd. of the blasted rock, shown in the photograph, per 10-hour day. It was installed for the Kokomo Stone Company, by the Vulcan Shovel Company, Toledo, Ohio.

500-VOLT TUNGSTEN LAMPS.

The Buckeye Electric Company, of Cleveland, claims the credit for making the first commercial installation of 500-watt "Mazda" lamps. The installation is on the main floor of the new Halle Brothers' store, in Cleveland, and consists of 30 of these new units in opal spheres. They burn at a consumption of practically 1 watt per candle and in the first two months of practical service not a lamp has broken or failed. The Halle store is a beautiful 12-story structure and is equipped with Buckeye "Mazda" lamps throughout. The management states

Tungsten Lamps in a Cleveland Store.

that up to the present there has been little or no need of taking merchandise to the door or where it could be examined under daylight, as all colors show up quite satisfactorily under the artificial illumination. On the first floor, especially, under the light of the 500-watt lamps the matching of color is very satisfactory.

SERIES STREET-LIGHTING CIRCUIT PROTECTION.

Open circuits in street-lighting systems are more or less frequent and not only result in interrupted service and grave danger to the public, but, also, where "outages" are penalized by the municipality, entail a loss of revenue to the central station. To meet this situation the device illustrated herewith has been developed.

Fig. 1 illustrates the general construction and assembly of the device, the weatherproof cover having been removed to permit a clear view of the various elements. A single magnetic circuit-control magnet provided with a movable core is so arranged as to actuate a pair of laminated copper brushes normally held by gravity against two stationary contacts to which the lamp circuit to be protected is connected. By means of heavy porcelain insulators the movable brushes are thoroughly insulated from each other, and in turn the stationary contacts are insulated from each other and ground. To each stationary contact is soldered a heavy lead carried through porcelain bushings mounted in a retaining case and so arranged as to be connected to that loop of the lamp circuit which is to be protected. To

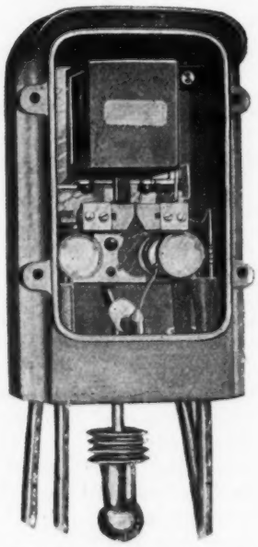


Fig. 1—Cut-out with Cover Removed.

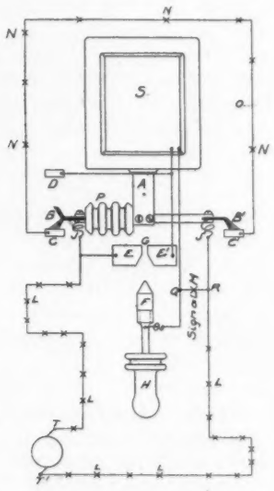


Fig. 2—Internal and Circuit Connections.

each laminated brush is secured a flexible lead encased in porcelain bushings and through suitable connections is attached to the main line from the generating station.

A pair of adjustable carbons mounted on insulators form a spark-gap in series with the control magnet and shunted across the main lamp circuit. One carbon is permanently connected to one side of the line and the other, in addition to this permanent connection, to the opposite side of the line. The latter carbon is connected to an auxiliary fixed contact and a movable contact is actuated by an insulated handle. It will be noted that the latter contact is of such contour as to fit the V-shaped portion of the carbon spark-gap.

The connections may be understood from the diagrammatic sketch shown in Fig. 2. The circuit under normal conditions is traced from the terminal T of a constant-current generator or transformer, through the series lamps LL, through the flexible lead J to the laminated contacts B and to the fixed contact C. From this point it continues through the series lamps N (circuit to be protected) to the fixed contact C^1, movable contact B^1, flexible lead J^1 and back to T^1, the opposite side of the source of supply.

Assuming a break to occur at O in the protected section extending from C to C^1, it will readily be seen that the full potential difference of the line will exist between the adjacent points of the gap formed by the carbon plates E, E^1. The spacing of this air-gap is such that the potential will immediately break across, and an instantaneous current will flow from the generator or transformer terminal T through the series lamps L, across the gap G, through the control magnet S and to the point Q. At this point a single lamp M is inserted between Q and R, thus completing the circuit through the remainder of the series lamps to the opposite side of the generator or transformer T^1.

The conditions outlined above will continue but a fraction of a second, as the current flowing through the control magnet S energizes the movable core A, causing it to be immediately drawn up, carrying with it the insulating porcelain P and brushes B, B^1, thus opening the lamp circuit N at the fixed contact C, C^1. The upward movement of the switching element causes the brush B to make connection with the fixed contact D, thus short-circuiting gap G and the fixed contact C, C^1. The circuit is thus continued through the control magnet S and the signal lamp M, which remains lighted as long as the magnet is energized, thus giving visual indication of trouble in the protected loop. Where this lamp indication is not desired the lamp may be omitted and permanent connections made between the points Q and R.

If, to meet local conditions, it is deemed advisable that the signal lamp M be made one of the regular lamps of the circuit, this can be accomplished by permanently connecting together Q and R and placing the lamp between R and J, under which condition it will always remain lighted except when trouble exists in the protected loop, such trouble then being indicated by extinguishing of the lamp.

After the break in the line at O has been reported, the lamp circuit N is still dead and can only be restored by pushing up the handle H, which brings F in contact with the carbon arcing pieces E, E_1, thus short-circuiting the control magnet S. Demagnetization of the core is thus effected and the plunger A falls by gravity, bringing the moving brushes B, B^1 into contact with C, C^1. Withdrawal of F, therefore, restores the circuit previously cut out and its re-establishment is indicated by extinguishing the signal lamp M (unless connected as noted above, in which case the conditions will be reversed).

If, however, the circuit has not been properly repaired, or a second break has occurred, withdrawal of F will cause the arc to be re-established across the gap G. The control magnet will be re-energized and the defective line again cut out in the same manner as above. This procedure will continue until the defective circuit is properly closed, as it is impossible for any other condition to exist with the arrangement shown. The device, of course, consumes no energy except when trouble exists in that part of the circuit containing the lamps N, and also the main contacts do not make or break any current when the cut-out operates.

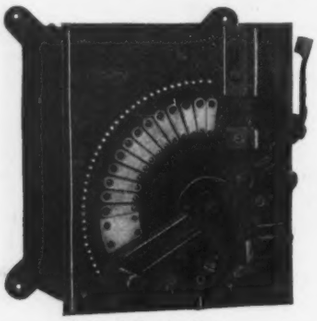
Some of the commercial advantages adduced in favor of the new method of protecting high-tension lighting circuits are as follows: Prevention of outages and accidents, automatic location of faults, automatic disconnection of ruptured circuits, facilitates quick and safe repairs to line, does not interrupt working parts of circuit, reduces number of circuits, effects considerable saving in wire, reduces number of station regulators and switchboards, and enables use of longer lamp circuits and reduces legal claims. The appliance is made by the Delta-Star Electric Company, Chicago.

SPEED CONTROLLER.

The speed controller illustrated herewith consists of a starting rheostat, the arm of which is provided with a projection carrying a sliding contact which moves over the contact buttons connected to the field circuit resistor. An auxiliary arm on the right-hand side of the rheostat front serves to maintain a short circuit on the field circuit resistor during the period of starting the motor, and on the starting resistor, when the arm is turned back to vary the running speed of the motor by regulating the field current.

When starting the motor, the starting arm cannot be left in any position on the contact buttons, due to the action of a

spring, but must be turned to the right until it engages the auxiliary arm, thereby forcing the latter to be retained by the no-voltage-release coil. The auxiliary arm then withholds the spring actuating the starting arm and thereby makes it possible to leave the arm in any position on the field circuit contacts, which will give the desired speed control of the motor. If the operator releases the rheostat arm at any position while it is being moved to the right during the starting period, it will immediately return to the off position. Upon failure of voltage the retaining coil is demagnetized,



Speed Controller.

thus releasing the auxiliary arm, which in turn releases the spring which carries the starting arm to the off position, thus opening the motor circuit.

The rheostat is so designed that it requires a little extra pressure to move the arm beyond the maximum speed point, the object being to call the operator's attention to maximum speed position so that he will not unintentionally bring the motor to rest. When it is desired to stop the motor the switch arm is thrown to the off position, thereby de-energizing the retaining magnet and releasing the auxiliary arm, which then opens the motor circuit. The maximum attainable speed variation is 3 to 1.

The speed controller here described has been placed on the market by the General Electric Company, Schenectady, N. Y.

SPRAGUE ELECTRIC FANS.

The well-known line of fans manufactured by the Sprague Electric Company has been improved this season and also covers a wider range of types. The new types comprise an 8-in.

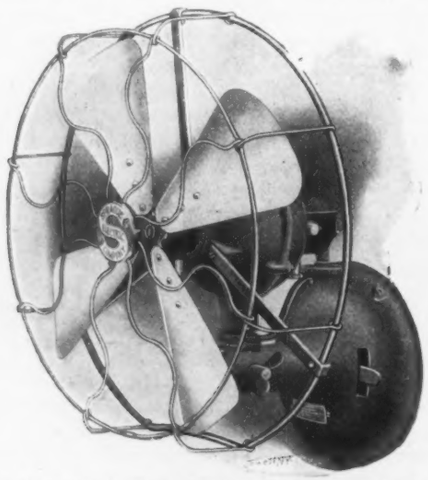


Fig. 1—Universal Joint Oscillating Fan, Bracket Type.

hinge joint desk and bracket fans, an 8-in. telephone-booth fan and a midget ceiling fan. The midget ceiling fan has a sweep of blades of only 32 in., and can be used in many places where the full-sized ceiling fan would be out of place. It is also furnished in white enamel, including the blades, so that it is an ornamental device as well. The desk and bracket fans this year have been improved by making the guard better and stronger.

The standard, or base, of these various fans has also been simplified, so that it is no trouble at all to change the non-oscillating universal-joint fan into an oscillating fan. The company has retained all the other features of excellence in design

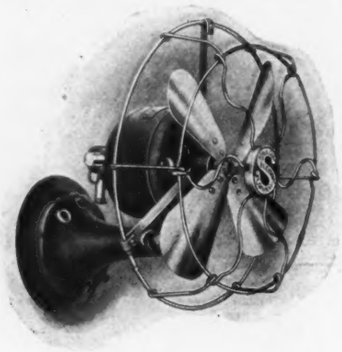


Fig. 2—8-inch Bracket Fan.

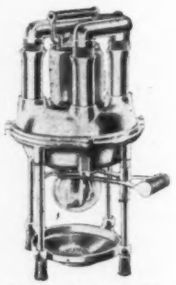
Fig. 3—Floor Column Fan.

and construction, to which are due lower energy consumption and minimum repairs. Sprague fans, it is claimed, displace a large amount of air, run quietly, require practically no attention and have an exceptionally long life.

MOTOR-DRIVEN AIR PURIFIER.

For ridding the air of a room of obnoxious odors, gas or smoke, within a few minutes, freeing it, as well, of the germs of disease, the pneumatic air cleanser described below is designed to "wash" the air rapidly. The air is drawn through it at the rate of 110 cu. ft. per minute, and is brought into intimate contact with an absorbent or disinfecting fluid. As illustrated, the device consists of a ⅛-hp universal motor mounted on a vertical shaft and driving a small centrifugal blower at 5000 r.p.m. The blast from this blower is passed over and thoroughly mixed with the disinfecting or perfumed fluid in the annular chamber in the middle of the apparatus, the treated air being then led to one or more nozzles which project it into the extreme parts and corners of the room. When the machine is operated, the air content of the room is thus passed through the mixing chamber at the rate of 110 cu. ft. per minute, and in this manner entirely disinfected.

A purifying and disinfecting fluid is supplied for use in the device, which destroys odors and also, it is said, any bacteria that may be present in the atmosphere, delivering the air sweet and clean. A hose and nozzle may be connected to the outlet for aerating clothing, bedding, portières, etc. By this method of sterilizing, the disinfectant used is under the close control of the operator, who may employ well-known harmless agents, varying the composition of the mixture to suit the special needs of his work. The device has also been successfully used for the diffusion of perfumes throughout large halls or houses, a few minutes' use sufficing to pervade the entire building with the delicate scent of the perfume used. The odor of stale tobacco smoke may also be removed quickly from a room. The pneumatic air cleanser is made by the Duntley Manufacturing Company, Chicago. It weighs, complete, 10 lb., stands 16 in. high and can be operated by attaching to any lamp socket, either direct current or alternating current.



Motor-Driven Air Purifier.

Industrial and Commercial News

THE WEEK IN TRADE.

ADVERSE weather conditions did much last week to check retail trade, and almost put an end to re-order business for spring goods. The crop damage resulting from the sudden return of winter has tended to discourage fall business, and merchants generally are inclined to hold off until more definite information as to the actual crop conditions is received. It is generally believed that the actual damage to growing crops will not be as severe as at first anticipated. Owing to the early start which the previous good weather had given to planting, it is believed that many crops can be replaced without much loss. This, however, means that instead of the season being a forward one, it will be backward, and a backward season always tends to check retail buying. The reports that are received from the wholesale and jobbing trade, and from all classes of manufacturers, indicate that there has been a slowing down in the activity that was apparent six weeks ago. The weather has almost entirely stopped outdoor construction, and the building trades have suffered thereby. The only orders the jobbers are receiving at the present moment are those actually needed to fill in immediate demands. The textile trades do not reflect any expansion, and the condition both of the cotton and wool markets is unsatisfactory. The pig-iron production has been in excess of the demand, and some furnaces are blowing out. Prices of commodities have tended downward, and food productions as a whole are generally lower. The industries, with the exception of the textiles, continue to be fairly active, but orders are not as plentiful as they were a few months ago. Collections are not as good as formerly, due, of course, to the falling off in retail trade. Business failures for the week ended April 28, as reported by Bradstreet, were 189 as against 193 the previous week, 268 in 1909, 282 in 1908, 163 in 1907 and 139 in 1906.

THE COPPER MARKET.

DURING the past week the copper market suffered further declines. There was very little buying on the part of consumers, and takings for export were also extremely light. The speculative trading, which formerly sustained the market to a considerable extent, has almost entirely disappeared. This is due both to the advance in rates of discount, making it more difficult to carry copper, and to the fact that consumers are giving evidence of being better bargainers then heretofore. The statistical position of the market has not improved during the month of April. Figures, of course, are as yet incomplete, but the indications are that the deliveries for domestic consumption and for export have been in the neighborhood of 100,000,000 lb. There is every reason to believe that the production in April will exceed that of March, and will probably amount to something like 125,000,000 lb. This would indicate a surplus of 25,000,000 lb. One of the principal features discussed at the present time in the copper market is the question whether or not the Copper Producers' Association will dissolve, and official copper figures will cease to be obtainable. It is said that dissensions have arisen among the members of the association, and that if further statistics are published they will probably be incomplete, as some of the producers are opposed to sending in any more returns. The trouble which threatens to disrupt the association is said not to have originated with the Amalgamated, but with some outside producers. Prices last week were very much inclined to sag, and it is said that some sales were made at distinct concessions from figures that were officially quoted. One feature that has done much to check buying on the part of domestic consumers is the widely published statement that large producers have been quoting copper cheaper to European buyers than to those in this country. Exports for the month of April, as shown by Custom House figures, were 13,062 tons. The daily call on the metal exchange May 2 quoted standard copper as per the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.00	12.25	.....
May	12.00	12.25	12.12½
June	12.00	12.25	12.12½
July	12.00	12.25	12.12½

The London market closed May 2 as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	55	18	9	55	17	6
Standard copper, futures	56	18	9	57	0	0

INDUSTRIAL AND COMMERCIAL NOTES.

English Interests Buy Guayule Rubber Lands.—The authoritive announcement is made at Saltillo, Mexico, that Adolfo Marx and associates have sold their guayule rubber holdings in Mexico to a syndicate of Englishmen for $2,000,000 gold, and that the purchasers have just finished the organization of the Guayule Rubber Company, Ltd., to take over the property. The directors of the new company are Arthur Gordon Angier, William Bell Irving, Robert Kahn and Alfred Landauer, all of London, Eng., and William Young, of Saltillo. Mr. Marx and his friends held contracts for the use of the guayule shrub upon about six million acres of land, which are transferred to the English syndicate by the deal that has just been made. Mr. Marx and associates manufactured 2,181,277 pounds of rubber last year. It is stated that the Guayule Rubber Company, Ltd., will erect other large factories and will endeavor to increase the output of rubber to 5,000,000 pounds annually. The high prices of the crude product has stimulated the guayule rubber industry to such a degree that enormous fortunes are being rapidly made by the owners of land upon which the shrub grows. The price of the shrub has been advanced to $100 gold per ton in the Saltillo section. Some land gives a yield of two tons per acre.

Underground Trunk Lines for Telephones.—The American Telephone & Telegraph Company and the Chesapeake & Potomac Telephone Company, of Baltimore, have made application to the Maryland State Good Roads Commission for the right to lay conduits along the new road between Baltimore and Wilmington, Del. It is said that plans have been perfected to establish, at a cost of $12,000,000, an underground trunk-line system between Boston, New York, Philadelphia, Baltimore and Washington. Such a line would prevent the cities from ever being cut off from the outside world because of storms and other weather disturbances. The conduits will contain about 100 wires, laid in the ground just below the freezing line and so arranged as to be tapped at any point. The companies propose to complete the Boston-Washington line before undertaking any other extensions, but afterward it is planned to extend underground trunk lines to all the principal Western and Southern cities.

Electric Railway for Maryland East Shore.—Baltimore and New York capitalists are said to be planning the construction of an electric line on the eastern shore of Maryland, extending from a point on the Atlantic Ocean to Queenstown, Md., which will have boat connections with Baltimore. It is estimated that the new line will cost in the neighborhood of $1,500,000, and actual construction work will be gotten under way just as soon as the right-of-way can be procured. Efforts are now being made to purchase the necessary property and it is expected that the preliminary work will soon begin. The road, when completed, will be about 100 miles long and will extend from Queenstown to Easton, to Cambridge, to Salisbury, to Snow Hill and from the latter place to some point on the Atlantic. It is the plan of the capitalists behind the project to operate what is known as the new unit cars.

W. S. Barstow & Company.—Contracts for remodeling and enlarging the power plant of the Arlington Company, manufacturers of celluloid, at Arlington, N. J., have been signed by W. S. Barstow & Company, engineers, of New York. The plant, when completed, will have 1200-kw capacity and the installation will cost about $80,000. The same engineering company has, also, taken a contract to double the generating capacity of the Orange County Lighting Company, of Middletown, N. Y. A new building will be laid out for 1000-kw capacity, of which 500 kw will be installed at once.

Oklahoma Electric Company.—The Oklahoma Electric Company, of Oklahoma City, has brought proceedings to condemn a water-power site on the Washita River, near Ardmore. The company states that 8000 hp can be developed at a cost of about $155,000.

Report That Central Colorado Power Company Will Invade Denver.—It is reported that the Central Colorado Power Company has decided to make application for a franchise which will enable it to compete with the Denver Gas & Electric Company for the supply of electric light and power in Denver, direct to consumers. As inducements it is proposed to offer complete underground distribution and a low basic rate to consumers, possibly 6 cents per kw-hour, the present rate in Denver being 9 cents. The application for a franchise will, if made, be passed upon soon after filing at a special city election or at the regular election of next fall. At the present time the Central Colorado Power Company furnishes a good portion of the energy used by the Denver Gas & Electric Company. The steam plant of the latter company is used merely as an auxiliary. At the office of Henry L. Doherty & Company, the firm which operates the Denver Gas & Electric Company, the report that the Central Colorado Power Company would come into Denver was disbelieved. The statement was made that the Denver Gas & Electric was ready to buy all of its energy from the Central Colorado Company, as soon as a sufficient quantity is obtainable. The company is now producing 10,000 hp at the Soshone plant in Grand River and expects to be able to furnish 20,000 hp additional when the plant at Boulder is completed in July. At the office of William P. Bonbright & Company, which firm is interested in financing the Central Colorado Power Company, it was admitted that application for a franchise to operate in Denver was being considered.

Southern Power Company's Auxiliary Plants.—The Southern Power Company has contracted with the Westinghouse Electric & Manufacturing Company for steam-power machinery sufficient to equip three auxiliary plants of about 10,000 hp each. The three plants will aggregate 30,000 hp. The new plants will be located at Greensboro, N. C., Greensville, S. C., and Durham, N. C. The order includes Leblanc condensers, together with turbo-generator exciter sets, motor-generator exciter sets and switchboards for each station. It is the policy of the Southern Power Company to erect these steam auxiliary plants, in order to guarantee a uniform supply of energy in case of low water in the rivers. The company will shortly add a 24,000-hp generating plant at Ninety-nine Islands in the Catawba River.

Westinghouse Turbo-Generators.—The Missouri Valley (Ia.) Electric Light Company has just installed a 500-kw Westinghouse turbine-generator set for furnishing local light and power. The turbine is of the complete expansion type, utilizing steam at 125 pounds and exhausting into a vacuum of 28 inches. The first 1000-kw high-pressure turbine-generator unit in the new 5000-kw power plant of the Pillsbury Flour Mills Company, Minneapolis, Minn., has been contracted for with the Westinghouse Machine Company, East Pittsburg, Pa. The turbine element is supplied with steam at 175 lb. pressure and exhausts into a vacuum of 28 to 29 in., maintained by a Westinghouse-Leblanc barometric condenser. The new power plant will operate several flour mills of the Pillsbury Company at Minneapolis.

American Blower Company.—The American Blower Company, of Detroit, has furnished the Hudson & Manhattan Railroad Company with its entire supply of ventilating equipment. The following apparatus has been installed: At the Hoboken Station, two 140-in. steel plate fans, housed with pedestals and direct connected to 40-hp variable speed motors; two 100-in. steel plate fans, direct connected to 13-hp variable speed motors; at the Fifteenth Street Station, two 96-in. cone fans direct connected to 30-hp variable speed motors; at Morton Street shaft, two 180-in. steel plate fans direct connected to 55-hp variable speed motors; at Hudson Street Station, two 100-in. steel plate fans direct connected to 50-hp variable speed motors.

Canadian General Electric Expansion.—The Canadian General Electric Company, according to Second Vice-President and General Manager Frederic Nicholls, will expend, altogether, about $1,000,000 in the extension of its works at Peterborough.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Wilkes-Barre, Pa.; Thermopolis, Wyo.; Yorkton, Sask., Can.; Glen Elder, Kan.; Jacksonville, Fla.; Madera, Mex.; Denver, Col.; Brockville, Ont., Can.; Morton, Minn.; Dodge City, Kan.; Pearce, Ariz.; Oakley, Kan.; Hartford, Conn.; Waynesboro, Pa.; St. Louis, Mo.; Lincoln, Kan.; Livonia, N. Y.; Plainfield, N. J.; Kingman, Ariz.; Fort Dade, Fla.; Fort Crocket, Tex.; Savannah, Mo.; Fort Caswell, N. C.; Cleveland, Ohio; Wheeling, W. Va.; Modesto, Cal.; Centralia, Wash.; Sullivan, Ind.; Estancia, N. M., and Allerton, Ia.

Increase of Generating Plant of Hartford Light Company.—The progressive policy of the Hartford, Conn., Electric Light Company in promoting the sale of electricity by new methods, and for new and various purposes, has resulted in the rapid growth of its business. The company has long outgrown the capacity of its two water-power plants amounting to 3000-kw generating apparatus and has in its Dutch Point steam station four Westinghouse-Parsons turbo-alternators aggregating 7500 kw. It has recently become necessary still further to increase the generating capacity of that station, and an order has been placed with the General Electric Company for two 4000-kw turbo-alternators.

Big Electric Railway Project.—It has been announced in Washington that plans are being matured for an extensive system of suburban and interurban electric lines that may eventually stretch from Norfolk, Va., to Boston, Mass. The project under consideration has in view the building of lines including Norfolk, Richmond and Fredericksburg, and extending to Washington, Baltimore, Philadelphia, New York and New England. A promoting company, known as the Baltimore & Pennsylvania Company, has been granted a charter to establish a fast electric express service over these routes. The company starts out with a capital of $600,000, which may be increased as required.

Gyroscope Road in Alaska.—It is announced that Louis Brennan's gyroscope monorail system will shortly be given a practical test in Alaska. A contract has been signed which grants the exclusive right for the use of the device in Alaska to an American syndicate, headed by John Ballaine, of Seattle. New York financiers are said to be back of the project. Mr. Ballaine estimates that he can construct 100 miles of line from the Matamiska coal fields to Fairbanks, which will not exceed $3,000 a mile. If the initial road proves successful, it will be extended throughout Alaska.

Willimantic Gas & Electric Light Company.—The Board of Trade of Willimantic, Conn., has voted to accept the plan proposed by the Willimantic Gas & Electric Light Company to conduct a campaign for attracting new industries to the city. The company offered to advertise, at its own expense, but in the name of the board, the advantages of Willimantic as an industrial center, if the board would provide quarters which may be leased to small manufacturing concerns.

Proposed Winnipeg Permanent Electrical Exhibit.—The Winnipeg Development and Industrial Bureau, a civic organization, will, this year, make an electrical show one of the main features of the Annual Industrial Exhibition. Plans are also under way for having a permanent exhibition open all the year, at which free electric power will be supplied by the municipality for operating exhibits.

Apparatus for Brooklyn Rapid Transit.—The Westinghouse Electric & Manufacturing Company has taken a contract from the Brooklyn Rapid Transit Company for three 3000-kw rotary converters, together with transformers and switchboard apparatus. These converters are to be installed in the Bridge Street and Hudson Street substations. A switchboard was also ordered for the Williamsburg power house.

Illinois Maintenance Company.—The Illinois Maintenance Company, of Chicago, which heats buildings, preferably in groups, by contract, has lately taken over the large store of Siegel, Cooper & Company, and also the Republic and Steger office buildings. The company will operate the boilers in these buildings, with the privilege of furnishing steam to outside customers, after the requirements of the buildings are met.

Electrical Apparatus to Be Sold.—The General Electric Company has advertised that it will sell at public auction at the principal gate of its Schenectady plant, on May 10, a lot of apparatus that was originally ordered for the Ocean Shore Railway Company, of San Francisco. This apparatus consists of generators, transformers and motor generators.

Chicago Subway Telephones—The Chicago Subway Company began the construction of its automatic telephone plant last week. President Harris, of the Automatic Electric Company, says that all of the leading business concerns of the city have become subscribers of the new system.

Financial.

THE WEEK IN WALL STREET.

WALL STREET was in an extremely pessimistic vein last week, and prices for many stocks reached lower levels than those touched in the period of depression in February. The downward movement was set in motion by the reports from the West of serious crop damage. The severe storm that swept over the Mississippi Valley no doubt did great damage to growing crops, and certainly delayed planting in many sections. Wall Street was exactly in the temper to seize upon such discouraging news and exaggerate it until the market was almost demoralized. The selling movement was quite sharp for a few days, but in the last days of the month sustaining influences were brought to bear and liquidation was in a measure checked. During the week the directors of the United States Steel Corporation placed the common stock upon a 5 per cent basis, with the practical assurance that it would be kept there. This, however, did not start any important buying movement, and Steel common was lower after the announcement than before. The money market has something to do with this condition, and conservative traders are unwilling at the present time to undertake to carry large accounts. The export movement of gold from this country is believed to have reached its zenith. The shipments last week were unimportant, and the bank statement was little affected thereby. The money market advanced to between 5 and 7 per cent at one time, but this stringency is believed to be entirely temporary. Quotations May 2 were: Call 3 @ 6 per cent; 90 days 4¼ @ 4½ per cent. The quotations in the table are those of the close May 2.

NEW YORK.

	Apr. 25	May 2	Shares sold.		Apr. 25	May 2	Shares sold.
All.-Ch.	10½*	10	1,100	Int.-Met., pfd.	56¾	51¾	45,870
All.-Ch. pfd.	36½	33½	1,300	Mackay Cos..	89½*	88⅞*	100
Amal. Cop...	72⅛	65⅝	267,050	Mackay C., p.	77¾*	76½	533
Am. D. T...	20½*	20½*	——	Man. Elev...	137*	132	650
Am. Loc.....	49⅛	46¼	19,100	Met. St. Ry..	15*	15*	——
Am. Loc.,pfd.	113*	110*	200	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com...	81⅝	79¼	1,265,560
Am. T. & T..	135½	133½	14,760	Steel, pfd....	119¾	117	27,530
B. R. T.....	77¼	75¾	87,805	W. U. T....	70	67	3,110
Gen. Elec....	149¼	146	5,420	West'h., com.	62	62	6,600
Int.-Met.,com.	22	19½	45,400	West'h., pfd..	125*	125*	——

PHILADELPHIA.

	Apr. 25.	May 2.		Apr. 25.	May 2.
Am. Rys.....	45	45*	Phila. Elec.....	15⅜	15
Elec. Co. of A.....	12*	12*	Phila. R. T.....	19¼	15⅝
Elec. St. B'ty.....	60¾	58¼	Phila. Trac.....	86½	85
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	48¼	44⅞

CHICAGO.

	Apr. 25.	May 2.		Apr. 25.	May 2.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	120	120
Chi. Rs., Ser. 1....	99*	99*	Met. El., com.....	17	17*
Chi. Rs., Ser. 2....	29	28	Met. El., pfd.....	56	55
Com. Edison.....	114	113⅜	Nat'l Carbon.....	111½	109
Chi. Subways.....	2½		Nat'l Car., pfd.....	119*	119*

BOSTON.

	Apr. 25.	May 2.		Apr. 25.	May 2.
Am. T. & T.....	135¾	133¼	Mex. Tel.....	6¼	5⅝
Cum. Tel.....	149	147	Mex. Tel., pfd.....	7¼	6½
Edison E., Ill.....	250*	249¼	N. E. Tel.....	134*	133½
Gen. Elec.....	150*	145¾	W. T. & T.....	15½	15½
Mass. E. Ry.....	18	17	W. T. & T., pfd...	87	85*
Mass. E. R., pfd....	86	87			

* Last price quoted.
Shares sold for week of April 25 to April 30.

FINANCIAL NOTES.

Chicago Elevated Line Merger.—It is said that the unification of the elevated railroads in Chicago has been practically arranged. A deal is on foot involving a capitalization of $100,000,000, and the new project may be ready for operation by August 1. Henry A. Blair, who successfully reorganized the Chicago Railways Company, is the financier who has charge of the new consolidation. He represents a syndicate of New York bankers, including N. W. Harris & Company, and the National City Bank. Mr. Blair has not yet announced his cash offers, but they are said to be considerably more than the present market values of the stocks of the different companies. The capitalizations of the elevated roads in stocks and bonds are: Northwestern, $10,000,000 stock, $22,482,000 bonds; Metropolitan, $16,500,000 stock, $15,000,000 bonds; South Side, $10,323,800 stock, $8,000,000 bonds; Oak Park $8,656,100 stock, $5,000,000 bonds.

Michigan Merger Again Held Up.—The merger of Michigan electric properties which was declared operative the first of April, through the medium of a Maine holding company, has again received a setback. The Railway Commission of Michigan refused to permit the merging of the dozen properties which are owned by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia. The merged company was to have been called the Consumers' Power Company, and it was proposed to issue $20,000,000 of capital stock and $35,000,000 in bonds. These issues were not approved by the Michigan authorities, and the owners of the properties attempted to reach the same end by the incorporation of the Consumers' Power Company under the laws of Maine, to be used as a holding company of the stocks of the subsidiaries. This plan was strenuously opposed by the Michigan authorities, and it now announced that after a conference between the Railroad Commission and John C. Weadock, attorney for the owners of the property, the holding company project will be abandoned. The present plan is that each of the individual companies will operate separately and report to the Commission separately. Instead of one large bond issue being made, each company will ask permission to issue bonds on its individual property as fast as funds are needed.

Philadelphia & Suburban Elevated Railroad.—A charter has been granted to the Philadelphia & Suburban Elevated Railroad Company by the commissioners of Pennsylvania. The nominal capital of the new company is $1,000,000. Application will be made to the Philadelphia council on May 5 for a municipal franchise. It is said that over half of the bond issue, which will amount to between $16,000,000 and $20,000,000 has already been subscribed. The financial backers of the enterprise have not yet been announced. Work will begin immediately after the franchise is granted on the construction of the Broad Street subway, and it is proposed to have trains in operation within two and a half years.

Hartford Electric Light Company.—It is expected that the recommendation of the directors of the Hartford Electric Light Company, that the capital stock be increased from $2,400,000 to $3,000,000, will be unanimously approved by the stockholders. It is understood that the new shares will be issued at par. The stock is now quoted in the Hartford market at 230 bid. It is the intention of the directors to issue two lots of new stock of $200,000 each, and to permit $200,000 to remain in the treasury to be issued as needed. Part of the proceeds of the new stock will be applied to doubling the capacity of the power plant at Dutch Point. The stockholders' meeting will be held June 13.

Electric Consolidation in Louisville.—Negotations are being carried on in Louisville, Ky., looking to the consolidation of that city's gas and electric business. The Louisville Gas Company, which owns the Louisville Lighting Company and controls the Kentucky Heating Company, will probably form a combination with the Kentucky Electric Company, and thereby place all of the light, heat and power business in the hands of one corporation. A new franchise will probably be asked from the City Council, and probably a new company will be organized.

Iowa Telephone Company.—The stockholders of the Iowa Telephone Company, a Bell subsidiary, have authorized an increase in the capital stock from $4,000,000 to $10,000,000, to provide for retiring bonded and floating indebtedness. It is understood that practically all of the new stock will be taken by the American Telephone & Telegraph Company, which holds the floating debt. At the present time the Iowa Telephone Company has a total of 350,451 subscribers' stations, an increase of 67,366 during the year 1909.

E. E. Witherby Company.—Edwin E. Witherby, formerly connected with the United Gas & Electric Company, has organized the E. E. Witherby Company, with offices at 40 Wall Street, to deal in gas, electric and street railway properties. The other officers of the company are: Arthur L. Canfield, vice-president, and George A. Thomson, secretary and treasurer.

Delaware County Electric Company.—The Philadelphia Electric Company has purchased a controlling interest in the Delaware County Electric Company, of Media, Pa., from the Associated Gas & Electric Company, of New York. The Philadelphia company has long been interested in Delaware county, as it controls the Beacon Light Company, of Chester.

Light and Power Deal in Washington.—The H. M. Byllesby Company, of Chicago, has completed a deal whereby it takes over the Northwest Corporation, with gas and electric plants at Walla Walla, North Yakima, Free Water and Salem, Oregon, and other Northwestern cities. The price paid is approximately $5,000,000.

Sale of Russian Air Brake Plant.—The New York Air Brake Company has recently sold to the International Harvester Company a portion of its plant in Moscow, Russia. In explaining this transaction, C. A. Starbuck, president of the Air Brake Company, said that the company had disposed only of that portion of its plant devoted to the gas-engine business, and had no intention of disposing of the air brake plant. He said that during the war with Japan the Russian railroads, on account of lack of funds, were unable to purchase equipment, and that his company, in order to keep its plant busy, began the manufacture of gas engines, and developed a good business in that line. Now that the air-brake business has returned to normal proportions, the company has no desire to continue in the gas-engine business. He said the company had succeeded in establishing its brakes on all of the Russian railroads, which was the purpose in view when the Russian plant was established.

J. G. White & Company.—The annual report of J. G. White & Company, Inc., for the year, which ended Feb. 28, 1910, shows an increase in surplus from $338,406 to $391,394, after the payment of dividends on the company's preferred stock. The report states that during the past year arrangements were made to acquire the stock of the Canadian White Company in exchange for stock of the J. G. White Company, the latter being purchased for the purpose. President J. G. White says that the company is acting as designing and supervising engineers for important work in Canada amounting to several millions of dollars. At the present time no contracts on any other basis than "cost plus a fee" are entered on the company's books, nor have any of the subsidiary or affiliated companies any fixed price contracts. The balance sheet of the company shows total assets of $4,447,347. The surplus as above stated, is $391,394.

East Creek Electric Power Company.—The East Creek Electric Power Company, of St. Johnsville, N. Y., has been authorized by the Public Service Commission to issue a refunding mortgage upon all of its property for $3,000,000. The proceeds of the bond issue under this mortgage will be used to retire outstanding bonds and to purchase additional lands and water powers. The company is also authorized to increase its capital stock from $200,000 to $500,000, and use the additional $300,000 for the payment of moneys advanced for organization expenses and development. The company will enter into a contract with the Fonda, Johnstown & Gloversville Railroad Company for supplying 7500 hp for lighting and heating purposes. Among the plans formed is one for the development of water power on East Canada Creek at Inghams Mills.

New Orleans Railway & Light Company.—The annual report of the New Orleans Railway & Light Company for 1909 shows gross earnings of $6,034,324, as compared with $5,968,498 last year. The net surplus, after paying all fixed charges, was $660,473. During the year the company added a 5000-kw turbine and auxiliaries to its power plant. The report shows that on Nov. 1, Bertron, Griscom & Jenks purchased $2,581,000 of the company's 5 per cent refunding bonds. Hugh McCloskey, president of the company, says in his report that the physical condition of the property and equipment has been maintained in a high state of efficiency.

Public Securities Company of Chicago.—Announcement was made last week of the organization of a financial institution in Chicago for the purpose of financing traction, gas, electric, hydroelectric and timber properties. The new organization will be known as the Public Securities Company, and will have an authorized capital of $20,000,000. The board of directors and advisory board have been selected. The company was promoted by Homer W. McCoy, of the bond house of McCoy & Company. Mr. McCoy will be president of the new company. Among the directors are: Samuel Insull, president of the Commonwealth Edison Company; B. E. Sunny, president of the Chicago Telephone Company; Edward G. Cowdery, vice-president of the Peoples Gas Light & Coke Company; Thomas E. Mitten, president Chicago City Railway Company, and H. M. Byllesby, consulting engineer and financier. The advisory board is made up of prominent financiers and bank officials from every part of the West and South. The company's stock will be divided into 100,000 shares of first preferred, 20,000 shares of second preferred and 80,000 shares of common.

Atlanta Hydroelectric Power Company.—Circulars are being sent out inviting subscription to the $3,000,000 issue of 6 per cent bonds recently authorized in Georgia for the newly chartered Atlanta Hydroelectric Power Company. These bonds are offered at par, and carry with them a 50 per cent stock bonus. The company has acquired land and water rights in Habersham and Rabun Counties in Georgia, and in Oconee County in South Carolina, along the Tugaloo River and its tributaries. It is expected that a hydroelectric development of 25,000 hp can be constructed. It is proposed to sell the energy in Atlanta and other Georgia cities.

DIVIDENDS.

American District Telegraph Company, of New York, semi-annual, 1 per cent, payable May 2.

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable June 1.

Consolidated Gas Company, New York, quarterly, 1 per cent, payable June 15.

Electric Properties Company, preferred, quarterly, 1½ per cent, payable May 10.

Metropolitan West Side Elevated Railway Company, Chicago, preferred, quarterly, ¾ per cent, payable June 1.

Ohio Traction Company, preferred, quarterly, 1¼ per cent, payable May 2.

United Wire & Supply Company, quarterly, preferred. 1¾ per cent, common, 1 per cent, both payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company:					
March, 1910	$516,699	$299,779	$216,920	$110,937	$105,983
March, 1909	452,596	264,371	188,225	106,351	81,874
Detroit United Railway Company:					
March, 1910	725,232	470,406	254,826	161,871	105,029
March, 1909	589,287	360,743	228,544	152,090	88,442
General Electric Company:					
11 Months ended Dec. 31, 1909	54,102,051	47,608,380	6,493,671	.....	.....
12 Months ended Jan. 31, 1909	47,168,467	42,366,216	4,802,252	.....	.....
Kansas City Railway & Light Company:					
March, 1910	622,555	347,083	275,471	160,665	114,806
March, 1909	561,774	315,171	246,603	156,799	89,803
Massachusetts Electric Companies:					
Quarter ended March 31, 1910	1,767,153	1,256,599	510,554	470,532	40,022
Quarter ended March 31, 1909	1,613,034	1,238,264	374,770	450,698	75,928
National Light, Heat & Power Company:					
Year 1909	791,481	410,576	380,905	185,834	195,071
Year 1908	731,582	412,255	319,327	151,624	167,703
New England Telephone & Telegraph Company:					
Year 1909	12,080,782	8,902,833	3,183,949	2,191,866	992,083
Year 1908	11,259,130	8,698,718	2,560,412	2,560,412	483,571
New Orleans Railway & Light Company:					
Year 1909	6,034,325	3,328,901	2,705,424	1,571,769	660,474
Year 1908	5,968,498	3,364,985	2,603,513	1,566,790	570,494
Niagara, Lockport & Ontario Power Company:					
March, 1910	38,956	16,936	22,020	20,833	*2,330
March, 1909	27,658	15,695	11,963	20,833	*3,451
Philadelphia Company:					
March, 1910	1,907,891	974,144	933,747	.....	.....
March, 1909	1,630,172	799,826	830,346	.....	.....
Sao Paulo Tramway & Light Company:					
Year 1909	2,439,486	846,627	1,592,859	371,986	1,220,873
Year 1908	2,287,411	783,051	1,504,360	365,468	1,138,89
United Electric Company of New Jersey:					
Year ended March 31, 1910	3,277,384	1,411,328	1,866,056	779,226	1,086,83
Year ended March 31, 1909	2,901,691	1,292,622	1,609,069	779,210	829,859

*Deficit.

General News

Construction News.

BEAR CREEK, ALA.—The construction of a hydroelectric power plant in Bear Creek is reported to be under consideration by N. W. Benefield and associates. The proposed project will include the construction of a dam, installation of water wheels and electric generating machinery.

BIRMINGHAM, ALA.—It is reported that negotiations between the Sloss-Sheffield Steel & Iron Company and the Birmingham Railway, Light and Power Company, with a view of the last-named company equipping the mines of the former for electrical operation, have been broken off, and that the Sloss-Sheffield Company will immediately make arrangements to equip all its mines to be operated by electricity.

CITRONELLE, ALA.—It is reported that H. Riedmann and associates are considering establishing a private electric light plant.

GUNTHERSVILLE, ALA.—A company has been organized in Guntersville to build an electric light plant in this town. D. C. Jordan is president, J. H. Carter vice-president, and Alexander Gilbreath treasurer.

LOUISVILLE, ALA.—The citizens of Louisville are contemplating the construction of an electric light and water plant. It is proposed to sink artesian wells and pump the water into a reservoir to supply consumers all over the city.

OPELIKA, ALA.—The Alabama Electric Light & Power Company has submitted a proposition to the City Council offering to furnish electricity for lighting the streets of the city for a term of years. The city recently voted to issue $85,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant and water works system. C. G. Abercrombie is president of the Alabama Electric Light & Power Company.

KINGMAN, ARIZ.—Plans are being considered to increase the output of the electric power plant owned by the Tracy Engineering Company. The cost of the work is estimated at about $30,000, and will include the installation of additional machinery.

PEARCE, ARIZ.—It is reported that the plant of the Commonwealth Mine & Milling Company, recently destroyed by fire, will be rebuilt at once. It is understood that new engines, generators and auxiliary equipment, together with concentrating machinery, will be required.

WICKENBURG, ARIZ.—The American Reduction Company, which has installed a five-stamp custom mill in Wickenburg, Ariz., is reported to have decided to install an electric plant to operate its mill, machinery for which will be purchased at once.

GREEN FOREST, ARK.—A company has been organized by Benjamin Harbert, F. R. Morrow, R. L. Jernigan, W. L. Sneed and J. B. Reeves for the purpose of constructing an electric light plant and cold storage and ice plant. The cost of the plant is estimated at $5,000.

JUDSONIA, ARK.—T. H. Beals is reported to be interested in a project to erect an electric light plant and a small cold storage plant.

LITTLE ROCK, ARK.—At the next meeting of the City Council the Hydro-Electric Power Company, of Murfreesboro, Ark., will apply for a franchise to furnish electricity in Little Rock. Surveys are now being made for the erection of a dam across the Little Missouri River, 60 ft. high and 1000 ft. long. Contract for construction of the dam will be awarded as soon as surveys are completed. It is estimated that 10,000 hp can be developed. Claudius Jones is president of the company.

BANNING, CAL.—The Consolidated Reservoir & Power Company has commenced work on the diversion of the Whitwater River at a point 7000 ft. above the sea level in the San Bernardino range, to irrigate land at Banning. The water will be carried through a pipe line for 15 miles, and will be utilized to generate electricity at two points along the way.

FRESNO, CAL.—Plans are being considered by the San Joaquin Light & Power Company for opening up 5500 acres in the vicinity of Pollasky, which will be done by sinking wells and providing power for pumping on a large scale for an irrigating system. It is said that the company will extend its transmission line from the copper mine to Pollasky, by the way of Gordan. No date has yet been set for doing the work. A. G. Wishon is manager of the San Joaquin Light & Power Company.

LOS ANGELES, CAL.—The street committee has approved of plans for ornamental illumination of Seventh Street, from Hoover to Boyle Street, a distance of four miles; and Sixth Street, from Main to Alameda Street. Under the proposed plan the property owners have to pay for the ornamental posts and for electric current on alternate years.

MANHATTAN, CAL.—The Manhattan Beach Improvement Association has appointed a committee to arrange for the installation of a street lighting system. H. K. Bennett is president of the association.

MODESTO, CAL.—Arrangements have been made with the Santa Fe Railway by the La Grange Water & Power Company for erecting its transmission lines along the right of way of the railway from Riverbank to Oakdale. It is understood that the power company proposes to establish an auxiliary plant at Riverbank and supply the towns along the Santa Fe.

OAKLAND, CAL.—The contract for furnishing 15 miles of cable for fire alarm system in Oakland, Cal., has been awarded to the Waterbury Company, of New York, N. Y.

PRINCETON, CAL.—An initiative movement has been taken by D. Washington Dodge, of San Francisco, owner of valuable sites in the Boggs Unit for electrical service for this district. It is stated that Glenn Brothers, of Jacinto, Cal., have submitted a proposition offering to build a transmission line down the river on the west side, if the people will subscribe for service that would average 150 hp for every 10 miles. The proposed line will probably be extended south from St. John, thereby giving all the colonies of the Jacinto, Parker and Boggs Units the advantage of the service.

SAN DIEGO, CAL.—Plans are being prepared by the San Diego Consolidated Gas & Electric Light Company to place its wires underground in the business district of the city. The City Council is considering an ordinance requiring the telephone, street railway and telegraph companies to place their wires underground on Fifth and D Streets before the end of the present year.

SAN FRANCISCO, CAL.—The Park Commissioners are reported to be considering the question of installing an electric light plant, for which the sum of $20,000 has been asked.

SAN FRANCISCO, CAL.—The Northern California Power Company has filed condemnation suits in Shasta County for the purpose of securing lands for the construction of a storage reservoir on Dry Burney Creek. The proposed reservoir will cover 1540 acres, and a dam 238 ft. high will be built. The company proposes to increase the output of its Kilarc power plant from 4000 to 7000 hp and build an auxiliary plant further down the stream, using the same water again, and generate 4000 hp more. The proposed dam is located eight miles from Kilarc in Dry Burney Creek Basin. A tunnel 7000 ft. long will be dug through the divide between Old Cow Creek Valley and Dry Burney Creek Basin to convey the water. The company, it is said, also proposes to utilize the water again at or near Millville for irrigating the arid lands between Millville and Anderson.

WILLOWS, CAL.—The Board of Town Trustees has instructed the city engineer to erect a transmission line to the sewer farm and install a motor and pump to take care of the sewage, work on which will begin as soon as possible. J. D. Crane is Mayor.

DENVER, COL.—The Grand Valley Fruit & Water Company, which owns extensive tracts of fruit lands in Utah, has engaged the Hampson-Fielding Engineering Company, of Denver, Col., to prepare plans and specifications for the construction of a power plant for irrigation purposes. It is estimated that about 3000 hp will be required. Charles M. Hampson is president of the engineering company.

DENVER, COL.—It is reported that plans have been completed for the construction of a large irrigation project, by which between 300,000 and 400,000 acres of land east of Denver will be reclaimed, for which notice of appropriation of water rights have been filed in the office of the state engineer. The water is to be taken from the Blue River, near Dillon, brought through the range to Clear Creek, near Silver Plume, to the Platte River. The names of the parties interested in the enterprise have not yet been made public.

HAYDEN, COL.—The Commercial Club of Hayden is inviting applications for a franchise to furnish electricity for lamps in the town of Hayden. The town now has a population of about 500, but is expected to reach 2000 by the end of the year as the terminus of the only railroad in the heart of the last cattle land of Colorado. It is expected that the Moffat Road will be completed this season, of which Hayden will be the terminus.

HARTFORD, CONN.—It is reported that the Hartford Electric Company has decided to increase its capital stock from $2,400,000 to $3,000,000. A meeting of the stockholders will be called June 15 for approval of same. Part of the proceeds of the new stock will be used to double the output of the plant at Dutch Point.

PLAINFIELD, CONN.—Plans are being made by the Lawton Mills Company to erect an electric light plant on the property recently purchased of Walter Kingsley.

ROCKY HILL, CONN.—It is reported that the Hartford Lighting Company is contemplating extending its transmission lines through Rocky Hill to the C. E. Billings plant, at Dividend.

WILLIMANTIC, CONN.—The Board of Trade has voted to accept the plan proposed by the Willimantic Gas & Electric Light Company to conduct a campaign for attracting new industries to this city. The company offers to advertise at its own expense, but in the name of the board, the advantages of Willimantic as an industrial centre, if the board would provide quarters which may be leased to small manufacturing concerns that can be induced to locate in Willimantic.

WILMINGTON, DEL.—Charles Baird & Company have awarded the contract for equipping their plant for electrical operation to E. F. Higgins & Company.

FORT DADE (P. O., EGMONT), FLA.—Sealed bids will be received by the Constructing Quartermaster, Fort Dade, Fla., until May 20, for the construction of an electric light system, including inside and outside wiring, addition to power house, engines, generators and transformers.

JACKSONVILLE, FLA.—At a meeting of the stockholders held April 20 at the office of D. G. Zeigler, in Jacksonville, Fla., the Suwanee River Electric Company decided to accept an offer for one-half interest in the company made by Albert Fendig and others, of Brunswick, Ga., for a consideration of $50,000, and who also agree to underwrite and dispose of the bonds to secure funds to be used for the construction and equipment of the proposed plant, work on construction of which will begin at an early date. It is understood that bids will soon be called for construction of the plant. D. G. Zeigler, of Jacksonville, Fla., is president and general manager of the company.

TAFT, FLA.—The Prosper Colony Manufacturing Company has been organized with a capital stock of $100,000 for the purpose of establishing a colony. It is proposed to establish an electric light and ice plant and other manufacturing plants.

CARTERSVILLE, GA.—The Riverside Milling & Power Company has submitted a proposition to the City Council offering to furnish water power for operating an electric light plant. A committee has been appointed to investigate the matter and employ experts, etc., and report later to the Council.

CYRENE, GA.—Rev. Z. J. Edge, of Cyrene, Ga., would like to receive prices on electrical equipment.

FAIRBURN, GA.—The town officials are considering the question of establishing an electric light plant and water works system, at a cost of about $30,000.

VALDOSTA, GA.—The Valdosta Street Railway Company is planning to extend its street railway system through several streets of the city, forming a belt line. W. S. West is president and general manager.

HAILEY, IDAHO.—Surveys are being made for the construction of a power plant on Silver Creek, between Hay Spur and Picabo, to supply electricity for lamps and motors to ranchers in that vicinity. Stewart Campbell is engineer.

IDAHO FALLS, IDAHO.—We are informed that bids will be received until May 18 for $95,000 in bonds, which were recently voted for construction of an electric light plant and water works system. The plant will be located on the Snake River, directly opposite the Idaho Faces, and will be entirely new. T. H. Hines is city clerk.

MINIDOKA, IDAHO.—The Secretary of the Interior has awarded the contract for electrical equipment for substations in connection with the Minidoka irrigation project to the General Electric Company, of Los Angeles, Cal., for $9,684.

ELDORADO, ILL.—The Egyptian Traction Company has been granted a 50-year franchise by the City Councils of Harrisburg, Eldorado and Carrier Mills. The company is now negotiating with the Councils of Marion, Carbondale and New Haven for similar franchises. G. E. K. Hixon is general manager.

HAVANA, ILL.—The Havana Electric Light Company is reported to be considering the construction of a new power house or remodeling the present plant.

PORT BYRON, ILL.—Surveys are being made by the Tri-City & Northeastern Interurban Railway Company for two new routes for its proposed electric railway from Albany. One route will extend from Hampton to Silvis and Moline, and the other 1½ miles above Hampton to Silvis and Moline. J. W. Simonson, of Port Byron, Ill., is president of the company.

ROCKTON, ILL.—It is reported that a large dam will be built across Rock River at Rockton, where it is estimated that 2000 hp can be developed. Chicago capitalists, headed by Bradner Smith & Company, are interested in the project. It is understood that about $1,000,000 will be expended in the enterprise.

TAYLORVILLE, ILL.—Contracts are now being placed by the Taylorville Railway, Light, Heat & Power Company for material for its proposed extension to Jayne Park, a distance of 4½ miles. W. B. Adams, of Taylorville, Ill., is manager.

WASHBURN, ILL.—John Moll, of Moweaqua, Ill., is reported to have purchased the local electric light plant, owned by the Consolidated Light & Manufacturing Company, of Assumption, Ill. The price paid for the plant is understood to be $12,500.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has contracts for the erection of a large number of new electric street signs for local firms doing business in the cities touched by the company's railway.

INDIANAPOLIS, IND.—The Co-operative Telephone Company has filed notice of increase of capital stock from $10,000 to $15,000. W. J. Maiden is president.

INDIANAPOLIS, IND.—On the advice of City Engineer Klausman, the Board of Public Works has made a ruling that all private street lamps must be uniform and conform with the design of those erected by the Merchants' Heat & Light Company on Washington and Meridian Streets.

NEW BELLSVILLE, IND.—The plant and holdings of the New Bellsville Telephone Company have been purchased by the Pike's Peak Telephone Company. The capital stock has been increased to $10,000. It is proposed to repair the lines and improve the service.

SULLIVAN, IND.—The City Council has granted the Sullivan Electric Company a 25-year franchise (an extension of its present franchise), in return for which the company agrees to make improvements to its plant, at a cost of about $15,000, and to furnish arc lamps for street lighting at the rate of $60 each per year, the same rate as under the old franchise. All incandescent lamps are to be furnished under meter rates.

TERRE HAUTE, IND.—Preparations are being made by the Wabash Manufacturing Company, of Wabash, Ind., to remove its plant to Terre Haute, Ind. A 125-hp boiler and a 100-hp engine are being installed in the new plant, and it is understood that an electric generator will be added to operate an electric welding machine and lighting system.

ALLERTON, IA.—Sealed bids will be received by the Mayor and Town Board of Allerton, until May 17, for furnishing material and construction of a municipal electric light plant, as follows: Item 1—One 80-hp producer gas engine for belt connection to generator; one producer gas outfit complete. Item 2—One 50-kw generator, belt driven, switchboard, arc regulators, arc and tungsten lamps. Item 3—Poles. Item 4—Line material. Item 5—Erection of above material, engine and producer excepted. Plans and specifications are on file at the office of S. F. Shields, city clerk, Allerton, Ia., and at the office of L. G. Knapp & Company, Kansas City, Mo., consulting engineers.

BOONE, IA.—The citizens are reported to have voted to grant the Boone Electric Company a 25-year franchise. It is understood that the company will expend $50,000 in improvements and extensions to its system.

OAKLAND, IA.—The citizens have taken decided steps toward the establishment of a municipal electric light plant. A committee has been appointed to look into the question and to make a report, when further steps will be taken in the matter.

BELLEVILLE, KAN.—Preliminary surveys are being made by the Motor Grand Traction Company for its proposed railway between Belleville and Wichita, 150 miles in length. E. S. Alnutt, of Belleville, Kan., is president and manager.

DODGE CITY, KAN.—At an election held recently the citizens voted in favor of the proposition to issue $50,000 in bonds, the proceeds to be used for the construction of a power plant and $29,000 for purchasing pipe lines. The J. P. Worley Company, of Kansas City, Mo., has charge of the engineering work.

GLEN ELDER, KAN.—John Abraham, of Waconda Springs, Kan., is reported to be interested in a project to install an electric light plant in Glen Elder. The cost of the plant is estimated at about $10,000.

LINCOLN, KAN.—Bids will be received by the city clerk until May 16 for equipment for the municipal electric light and water plant, as follows: One 125-hp engine direct connected to a 75-kw generator and exciter; one 75-hp horizontal high-speed engine, belt connection; one water heater; one feed pump; two 125-hp high pressure tubular boilers, piping, valves and fittings. Plans and specifications will be furnished on application to the city clerk.

OAKLEY, KAN.—The proposition to issue $40,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system was carried at a recent election.

GLASGOW, KY.—The Louisville, Lincoln Farm & Mammoth Cave Traction Company ,recently organized, will purchase the franchises and rights of way already secured from the City Council of Glasgow over the L. and N. turnpike through the fiscal courts, from Glasgow to New Haven, Ky., together with private rights of way from Buffalo, via Lincoln Farm to Hodgeville, Ky. A large hydroelectric plant will be built where the road crosses at Green River, near Linwood, Ky. The company is capitalized at $1,000,000. J. M. Richardson is president.

MANDEVILLE, LA.—Material for the new electric and ice plants to be erected on Villere Street has arrived. A. D. Piaggio is president of the company.

BANGOR, MAINE.—The Trustees of the Eastern Maine Insane Hospital are reported to have made arrangements with the Bangor Railway & Electric Company whereby the latter will furnish electricity for lamps and motors at the hospital, instead of generating power on the premises. Under the terms of the contract the arrangement can be terminated at the end of one year.

PORTLAND, MAINE.—Work has commenced on the construction of a new electric railway to connect Portland and Lewiston, Maine, 35 miles in length. The cost of the proposed railway is estimated at $800,000. The new line will pass through Auburn, Gloucester, Cumberland, Gray, West Falmouth and Deering.

ANNAPOLIS, MD.—Plans have been completed by the Baltimore & Pennsylvania Railway & Power Company for the construction of an electric railway between Hanover and Reisterstown, Md.

BALTIMORE, MD.—The United Railways & Electric Company has awarded the contract for construction of an addition to its Pratt Street power house to John Cowan, of Baltimore, Md., at a cost of $5,500.

BALTIMORE, MD.—Wehr, Walden & Dukehart, Continental Building, Baltimore, Md., who recently prepared plans for the construction of

a concrete gravity dam on the Patapsco River, are now ready to receive bids for construction of the same.

BALTIMORE, MD.—Plans are being prepared by Mr. McCuen, superintendent of lamps and lighting, for the installation of a municipal plant to furnish light, heat and power for the municipal buildings. It is proposed to install a plant of sufficient size to serve the courthouse, city hall, the annex on North Street and Board of Health quarters in the old city hall building.

BALTIMORE, MD.—The Sisters of the Notre Dame, Charles-Street Avenue Extension, has awarded a contract to Crook, Kries & Company, of Baltimore, Md., for the installation of heating and ventilating apparatus, engine and generator. The entire power plant will be remodeled, the improvements to include the installation of 250-hp water tube boiler, extension of cable mains from power house to buildings in tunnels, etc. The cost of the work is estimated at $25,000. Charles L. Reeder, Equitable Building, Baltimore, Md., is consulting engineer.

BALTIMORE, MD.—Plans are being considered by the American Telephone & Telegraph Company and the Chesapeake & Potomac Company, of Baltimore, Md., to establish an underground trunk line telephone service between Boston, New York, Philadelphia, Baltimore and Washington. The telephone company has applied to the Good Roads Commission for Maryland for a permit to lay conduits along the new State road between Baltimore and Wilmington. It is proposed to continue the line to Washington. The proposed plan will involve an expenditure of more than $12,000,000.

ELKTON, MD.—The plant of the James F. Powers Company is being gradually equipped for electric motor drive throughout. Electricity for operating the machines is secured from an outside plant.

AMESBURY, MASS.—The Amesbury Electric Light Company has been granted permission by the State Board of Gas and Electric Light Commissioners to issue $20,000 in capital stock.

FISHERVILLE, MASS.—Plans are being made by the Fisher Manufacturing Company for the installation of an electric power plant to operate the mills of the company, replacing steam power. Albert W. Dimick is superintendent of the company.

LEOMINSTER, MASS.—Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., by the Massachusetts Lighting Company, of Boston, Mass., for a barometric condenser and centrifugal pump for the plant of the Leominster Electric Light & Power Company, of Leominster, to furnish water to the turbo-generator set recently purchased from the Allis-Chalmers Company.

MALDEN, MASS.—Contracts have been placed by the Malden Electric Company for placing its wires underground in the principal streets of the city, at a cost of $55,000.

SHELBURNE FALLS, MASS.—The Shelburne Falls Electric Light & Power Company has applied to the State Board of Electric Light and Gas Commissioners for permission to issue $50,000 in additional capital stock, the proceeds to be used for additions to its plant.

SOUTHBRIDGE, MASS.—Work has commenced on the construction of a power plant for the Hamilton Woolen Company in Southbridge. The cost of the plant is estimated at $20,000.

CHARLOTTE, MICH.—The property of the Charlotte General Electric Company was recently sold at a chancery sale by J. C. Nichols, circuit court commissioner, to M. W. Eaton, of New York, N. Y., and W. A. Foote, of Jackson, Mich., for $30,000. Interests connected with the Commonwealth Company have had charge of the plant for some time.

ESCANABA, MICH.—The Escanaba Power Company is reported to have awarded the contract for hydraulic turbines for its Au Train plant to the Pelton Water Wheel Company, of San Francisco, Cal.

GRAND RAPIDS, MICH.—Plans have been prepared for the construction of an addition to the Macey Company's factory, 100 ft. x 125 ft., which will be equipped with motors, blowers, heating apparatus, sprinkler system and other machinery.

HANCOCK, MICH.—Preparations are being made by the Quincy Mining Company, of Hancock, Minn., for equipping its properties for electrical operation. Contracts have been placed for an exhaust steam turbine driving a General Electric generator rated at 300 kw. A large line of motors will be required eventually for use in the rock house, mill, handling plants and underground workings.

LANSING, MICH.—The Board of Water Works and Electric Light Commissioners has awarded the Allis-Chalmers Company, of Milwaukee, Wis., a contract for a 1000-kw, two-phase, 2300-volt, 60-cycle, 1800 r.p.m. steam turbo-generator and a type "C" generator.

ROCHESTER, MICH.—At a special election held recently the citizens voted to grant the Edison Illuminating Company, of Detroit, Mich., a franchise to supply electricity for lighting the village. Power for operating the system will be secured from Utica, seven miles distant. For several years past the Detroit United Railways Company has supplied electrical service in Rochester.

BRAINARD, MINN.—The municipal electric light and power plant, located at the Weyerhauser dam, was destroyed by fire April 24, causing a loss of about $40,000.

FOUNTAIN, MINN.—It is reported that surveys are being made for the construction of a dam and power plant on the north branch of the Root River, 1½ miles above Newmans' Ford, with a view of furnishing electricity for lamps and motors for towns in this vicinity. Messrs. Ober & Comstock, of Chatfield, Minn., are interested in the project.

MINNEAPOLIS, MINN.—Contracts have been placed by the Twin City Rapid Transit Company with the General Electric Company, of Schenectady, N. Y., for one 14,000-kw Curtis turbine and two 1500-kw six-phase rotary converters for its power house in Minneapolis, Minn.

MINNEAPOLIS, MINN.—The Pillsbury Flour Mills Company, of Minneapolis, Minn., has placed an order with the Westinghouse Machine Company, of Pittsburg, Pa., for a 1000-kw, high pressure, turbo-generator unit for its new 5000-kw power plant. The turbine is supplied with steam at 175 lb. pressure and exhausts into a vacuum of 28 to 29 in., maintained by a Westinghouse-Leblanc barometric condenser. The new plant will furnish electricity to operate the several flour mills of the company at Minneapolis, Minn.

MORTON, MINN.—We are informed that Wherland Electric Company will call for bids about May 31 for the construction of an electric light plant, the cost of which is estimated at about $20,000. The company has franchises and street lighting contracts in Morton, Morgan and North Redwood, Minn. R. F. Wherland is manager of the company.

ST. PAUL, MINN.—Plans are being prepared for Luther S. Cushing, of St. Paul, Minn., for improvements to the Endicott Arcade, in St. Paul, which includes the installation of a power plant to cost $35,000.

ST. PAUL, MINN.—The Great Northern Railway Company has recently placed orders for telephone apparatus for train despatching, to be installed on six more divisions of the road. The company already has 2100 miles equipped with telephones, and the new extension, which includes the Fergus Falls, Breckenridge, Northern Dakota, St. Cloud and Cascade divisions, will include about 1900 miles. The new work includes the complete equipment for 290 stations, and at sidings and way stations 350 telephones will be placed.

MARSHALL, MO.—The City Council is reported to be considering the question of installing an electric plant to furnish electricity for lighting the streets of the city, power for operating the system to be secured from the water works pumping station. The contract with the Marshall Light, Heat & Power Company for street lighting will expire Dec. 31, 1910.

MISSOURI VALLEY, MO.—The Missouri Valley Electric Light Company has recently installed a 500-kw Westinghouse turbo-generator set in its plant. The turbine is of the expansion type, utilizing steam at 125 lb. and exhausting into a vacuum of 28 inches.

ST. LOUIS, MO.—The National Lead Company is contemplating the installation of engine driven generating units with a rating of 500 kw in its St. Louis plant, to furnish direct current for operating motors, etc.

SAVANNAH, MO.—F. C. Barrington, president and manager of the Columbian Electric Company, of St. Joseph, Mo., who was recently granted a franchise to furnish electricity in Savannah, contemplates extensive improvements to the present system, which includes the rebuilding of the distributing system and electric lighting system, with exception of power house, where only transforming station equipment will be installed. Electricity for operating the system will be transmitted from St. Joseph, Mo., to Savannah, at 10,000 volts. Improvements will also be made to the water works system, including the installation of electrically driven pumps. The cost of the transmission line to Savannah is estimated at $10,000, and improvements to the system in Savannah at about $15,000.

CULBERTSON, MONT.—The Montana Star Telephone Company is contemplating extending its lines to Nashua, at a cost estimated at $15,000.

DILLON, MONT.—The capital stock of the Southern Montana Telephone Company has been increased from $10,000 to $40,000. The company proposes to make several extensions to its system.

BLAIR, NEB.—The plant and holdings of the Blair Electric Light & Power Company, of Blair, Neb., has been purchased by the Bullock Public Service Company. The price paid for the plant was about $38,000. E. V. Capps was president and manager of the Blair Electric Light & Power Company.

FAIRBURY, NEB.—At an election held April 26 the proposition to issue $135,000 in bonds for the construction of an electric light plant and water works system was defeated. R. E. Riley is city clerk.

JOHNNIE, NEV.—The Johnnie Mining & Milling Company, of Los Angeles, Cal., is reported to be considering doubling the output of its ore mills and the electrical equipment of its mines at Johnnie, Nev.

RHYOLITE, NEV.—The Tecopa Mining Company is reported to be contemplating the construction of a hydroelectric power plant.

LACONIA, N. H.—The Winona Lake Company is making surveys of the site of the proposed dam at Lakeport, with a view of constructing a reinforced concrete dam to replace the present dam. Henry W. Daniel, of Lakeport, N. H., is agent.

ARLINGTON, N. J.—W. S. Barstow, of New York, N. Y., has secured the contract for remodeling and enlarging the power plant of the Arlington Company, celluloid manufacturers, of Arlington, N. J. The plant when completed will have an output of 1200 kw and will cost about $80,000.

LONGPORT, N. J.—The Borough Council has passed an ordinance authorizing the construction of a municipal electric light plant in Longport. A. H. Phillips is Mayor.

PLAINFIELD, N. J.—The Board of Governors of the Muhlenberg Hospital has authorized an expenditure of $4,000 for the immediate installation at the hospital of an electric light and power plant and $3,000 for a refrigerating plant.

DEMING, N. M.—The Deming Ice & Electric Company is installing additional equipment in its power plant, which will increase the output by 400 hp. The company has contracted to supply electricity to operate irrigating pumping plants in this vicinity.

ESTANCIA, N. M.—Preparations are being made by the Western Construction Company for the construction of an electric plant with sufficient output to supply electricity for pumping water to irrigate 25,000 acres of land. The cost of the plant is estimated at $498,000. The initial installation and transmission system will provide for 11,000 acres.

SANTA RITA, N. M.—Application has been filed in the office of the territorial engineer at Santa Fe by the Chino Copper Company for water rights of the Apache Tejo Spring, near Santa Rita, where it proposes to erect a hydroelectric power plant. The proposed plant, it is understood, will cost about $250,000, and will furnish electricity to operate the machinery in the company's reduction mills and mines.

BUFFALO, N. Y.—The contract for eight 750-hp boilers for the new pumping station was awarded to Farrar & Treffts, of Buffalo, N. Y., for $185,000; the Holly Manufacturing Company was awarded contract for five 30,000,000-gal. steam pumps, at $674.769, and the Northern Engineering Company, of Detroit, Mich., for a 30-ton electric traveling crane. for $9,950.

CLAYTON, N. Y.—The Thousand Island Electric Light & Power Company has been granted permission by the Public Service Commission, Second District, to issue $20,000 in bonds at not less than 95, the proceeds to be used for payment of obligations and for improvements and extensions to its plant.

LIVONIA, N. Y.—The plant and holdings of the Livonia Light & Heat Company have been purchased by parties interested in the Avon Electric Company. The new owners propose to build a transmission line from the plant in Avon to Livonia, to furnish electricity to operate the local system. The Livonia plant will be closed and the entire system rebuilt. As soon as the transmission line is completed, a 24-hour service will be established in both Livonia and Avon. The officers of the new company are: C. W. Richardson, of Bath, N. Y., president; Gurney E. Lott, of New York, N. Y., vice-president; C. N. Quinby, of Rochester, N. Y., secretary, and E. D. Hamlin, of Avon, N. Y., treasurer.

LOCKPORT, N. Y.—Plans have been completed by the Simonds Manufacturing Company for the construction of a steel mill at Lockport, N. Y. The plant will be equipped throughout for electrical operation, energy for which will be obtained from Niagara Falls. The initial investment will be about $250,000. The company has factories in Fitchburg, Mass., Chicago, Ill., and Montreal, Can.

MIDDLETOWN, N. Y.—The Orange County Lighting Company has contracted with Barstow & Company, of New York, N. Y., for extensions to its power plant, which will double the generating capacity. The new building will be planned for an output of 1000 kw eventually. The initial equipment will provide for 500 kw.

NIAGARA FALLS, N. Y.—The Niagara Electrochemical Company, of Niagara Falls, N. Y., is reported to be contemplating the erection of an addition to its plant on Buffalo Avenue, Buffalo, N. Y.

WATERFORD, N. Y.—The contract for construction of the new power house of Cluett, Peabody & Company, of Waterford, N. Y., has been awarded to the Torrington Building Company, of Torrington, Conn.

WATERTOWN, N. Y.—The Public Service Commission, Second District, has authorized the Deer River Power Company, of Watertown, N. Y., to execute a mortgage on its property to secure an issue of bonds to the amount of $200,000. The company is to issue at present $67,000 at par value, to be sold at not less than $90, the proceeds to be used for obligations incurred by the company in its development on the Deer River, at High Falls and at various points above High Falls. The company proposes to generate electricity for transmission to Copenhagen for lamps and motors and in the County of Lewis and also in adjacent counties.

WILSON, N. Y.—The Public Service Commission, Second District, has authorized the Conant-Bryant Power Company to exercise its franchise to furnish electric light service in the village of Wilson. The franchise was originally held by Stuart M. Conant and Russell W. Bryant.

FORT CASWELL, N. C.—Bids will be received at the office of the Constructing Quartermaster, Fort Caswell, N. C., until May 25 for the installation of an electric power plant and lighting system. Plans and specifications can be obtained on application to the above office, for which a deposit of $10 will be required. Lieut. W. E. McCleary is constructing quartermaster.

LOBELIA, N. C.—The Morrison Mill site, on the Lower Little River, has been purchased by J. R. McQueen and others. It is reported that the new owners propose to erect a hydroelectric power plant to supply electricity to operate the Vass cotton mill at Vass, and also for lamps, 7½ miles distant.

AKRON, OHIO.—The Summit Rural Telephone Company has filed amendments to its charter, increasing its capital stock from $3,000 to $10,000.

ATHENS, OHIO.—The Nelsonville, Athens & Glouster Traction Company has petitioned the City Council for a franchise to construct and operate an electric railway in Athens.

BEREA, OHIO.—The city is considering the question of issuing $10,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant. O. P. Stone is city clerk.

CLEVELAND, OHIO.—Plans are being made by the Cleveland Railway Company for the installation of four new boilers in its power plants, at a cost of $65,727. The boilers are to have a rating of 500 hp each, and three of them will be placed in the Cedar Avenue power plant and one in the power plant at the viaduct.

COSHOCTON, OHIO.—Contracts have been placed by the Coshocton Light & Heating Company for equipment for its proposed hydroelectric power plant to be erected at the State dam in the Walhonding River. The initial installation will include two direct-connected turbines and generators with a rating of 1400 hp. Work will soon commence on the construction of the power house. With the present steam plant the company will have an output of more than 2500 hp. W. A. Heimbaugh is president of the company. It is understood that the entire output of the plant has practically been contracted for.

HAMILTON, OHIO.—The City Council has decided to call a special election to submit the proposition to issue $260,000 in bonds, the proceeds to be used for the extension to the gas, water, sewer and electric systems to a vote of the people.

MANSFIELD, OHIO.—The Mansfield Telephone Company has increased its capital stock from $350,000 to $1,000,000.

TIPPECANOE CITY, OHIO.—The Tippecanoe Telephone Company, recently organized, has purchased the property of the Tippecanoe Interurban Telephone Company and will make extensive improvements to the property.

TOLEDO, OHIO.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded a contract by the Toledo Railways & Light Company for the installation of a 6400-kva., three-phase, 25-cycle, 4000-volt, steam turbo-generator, which will operate in parallel with four Allis-Chalmers engines and two Curtis turbines, forming the present equipment of the plant. Ford, Bacon & Davis, of New York, N. Y., are engineers for the Toledo Railways & Light Company.

ARDMORE, OKLA.—The Oklahoma Electric Company, of Oklahoma City, Okla., is reported to have brought proceedings in Ardmore to condemn a water power site on the Washita River, near Ardmore. The company states that 8000 hp can be developed at the proposed site at a cost of $155,000.

FAIRVIEW, OKLA.—The City Council is contemplating making extensions to the municipal electric light plant and water works system.

HOWE, OKLA.—The construction of an electric light plant is reported to be under consideration. An election will soon be called to submit the proposition to a vote.

STILLWATER, OKLA.—Arrangements are being made by the Pioneer Telephone & Telegraph Company for extensive improvements to its system, which will include the construction of an entire new plant at a cost of about $40,000. The common battery system and a new switchboard will be installed. Work will soon commence on improvements to the plant.

ALBANY, ORE.—Application has been made to the City Council by the Oregon Electric Railway Company, of Portland, Ore., for a franchise to construct an extension through Albany. The company has recently been granted a 25-year franchise to build an electric railway in McMinnville.

AURORA, ORE.—The Aurora Electric Company is erecting a power plant in Canby, which will have an output of from 500 to 1000 hp. Provision will be made for enlargement.

FOREST GROVE, ORE.—The Haines Electric Company is reported to be contemplating extending its transmission lines to Hillsboro. The company will also furnish electricity for lamps to the small towns between the two cities.

FOSSIL, ORE.—James Stewart, of Fossil, Ore., and associates are interested in a project to construct an electric railway from Condon to Fossil, via Maryville, a distance of 20 miles.

UNION, ORE.—An election will soon be held to vote on the proposition to issue bonds for the construction of an electric light plant and water works system in Union. The cost of the plants is estimated at $75,572. Louis C. Kelsey, of Salt Lake City, Utah, is consulting engineer.

CLEARFIELD, PA.—The Central Pennsylvania Light & Power Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a 400 kva, 2300-volt, three-phase, 60-cycle, 100 r.p.m. alternator for direct connection to an engine, and also for a 22-kw exciter.

COLD SPRING PARK, PA.—The Huntingdon, Lewistown & Juniata Valley Traction Company has been granted a franchise to construct and operate a railway in Cold Spring Park.

EAST HANOVER, R.F.D., GRANTVILLE, PA.—The directors of the East Hanover Telephone Company have decided to increase the capital stock of the company to $25,000.

MILTON, PA.—The Lewisburg, Milton & Watsonville Passenger Railway Company is reported to be considering the extension of its railway for a distance of several miles. The company has awarded

a contract to the Allis-Chalmers Company for two 200-kw, 2300-volt, three-phase, 60-cycle, synchronous motor-generator sets to be installed in its new plant. C. S. Johann has charge of the engineering work.

PHILADELPHIA, PA.—Plans are being prepared by the electrical bureau for the installation of a new lighting system in the Frankford section.

PHŒNIXVILLE, PA.—The Phœnixville, Valley Forge & Strafford Street Railway Company has awarded the contract for the construction of its proposed electric railway from Phœnixville to Strafford, via Valley Forge, a distance of 10 miles, to the Phœnixville Construction Company. Thomas E. O'Connell, of West Chester, Pa., is president of the company.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has decided to purchase new equipment for its power plant in Waynesboro and substation at Pen Mar, which will involve an expenditure of about $40,000. The company has recently placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for a 500-kw, three-phase, 2300-volt, 3600 r.p.m. steam turbo-generator set and a type "C" condenser.

WILKES-BARRE, PA.—The directors of the Wilkes-Barre Gas & Electric Company have decided to make extensive extensions and improvements to its electric and gas plants and distributing systems, which will involve an expenditure of about $100,000, for which plans have already been prepared. Work will commence immediately on some of the improvements.

TYNDALL, S. D.—All bids for the proposed municipal electric light plant (which were opened April 14) were rejected. New bids will be called for later. J. J. Maus is city auditor.

TRENTON, TENN.—At an election held recently the citizens voted to purchase the local electric plant, owned by Keenan & Wade, for $9,300. An election will be held May 20 to vote on the proposition to issue $12,000 in bonds to establish an electric light system.

ABILENE, TEX.—The property of the Roberts Telephone & Electric Company has been sold by the receivers to a syndicate consisting of Lyman C. Klotz, of St. Louis, Mo.; Jones & Winters, of Chicago, Ill., and Mr. Lackey, vice-president of the Mississippi Valley Trust Company, of St. Louis, Mo. The price paid for the plant was $43,500. The wires will be placed underground in the business portion of the city and other improvements made.

ALPINE, TEX.—The Alpine Power Company has applied to the City Council for a 50-year franchise to supply electricity for lamps and motors in Alpine.

AUSTIN, TEX.—Application has been made to the Board of County Commissioners of Travis County by Claude Birdshead, an attorney of San Antonio, Tex., for a franchise to use the tracks that are laid across the new concrete bridge over the Colorado River at Austin, to secure entrance to this city for a proposed interurban electric railway to be built between San Antonio and Austin. The proposed railway will be about 90 miles long.

BEAUMONT, TEX.—Application has been made to the City Council by I. D. Polk, of Beaumont, for a 50-year franchise to construct and operate an electric street railway in this city; also for a franchise to install an electric light and power plant. L. D. Ross, of New York, N. Y., and other Eastern capitalists are reported to be interested with Mr. Polk in the project.

BRUNNER (P. O. HOUSTON), TEX.—D. D. Pittman, of Houston, Tex., is reported to have secured the contract for construction of power house for the electric light and water plant of the Brunner Water & Light Company.

BRYAN, TEX.—It is reported that the City Council has decided to install a municipal lighting plant.

DALLAS, TEX.—It is reported that H. M. Hyatt, of St. Louis, Mo., is promoting the construction of an electric interurban railway between Dallas and Cleburne, for which a company will soon be formed.

FORT CROCKETT, GALVESTON, TEX.—Bids will be received at the office of the Constructing Quartermaster, Fort Crockett, Galveston, Tex., until May 31 for the construction of an electric lighting system at this post. For further information address the above office. Captain P. Whitworth is Quartermaster, U. S. A.

HEMPSTEAD, TEX.—J. C. Amsler, of Hempstead, Tex., is reported to be interested in a project to form a company for the purpose of installing an electric light plant in Hempstead, to furnish electricity for lamps and motors. The cost of the plant is estimated at $10,000.

HOUSTON, TEX.—Application has been made by I. D. Polk for a franchise to construct and operate an electric light and power plant in Houston.

HOUSTON, TEX.—Arrangements have been completed by the Houston Bay Shore Traction Company for the construction of an electric railway between Houston and La Porte, a distance of 24 miles. A. Foster Irwin, of Detroit, Mich., is president.

HOUSTON, TEX.—The National Biscuit Company, of New York, is reported to have awarded a contract to the American Construction Company for the erection of a new plant, with a capacity of four times the present plant. An electric plant, sprinkler and refrigerating systems will be installed.

LOMETA, TEX.—The local electric light plant and water works system has been purchased by E. H. Gordon, of Coperas Cove, Tex. It is understood that the new owners will make improvements to the systems.

MEXIA, TEX.—W. L. Murphy, vice-president of the First National Bank of Mexia, has purchased the majority of the capital stock of the Mexia Telephone Company. A contract for the construction of a new exchange has been awarded by the company. The exchange will cost about $20,000.

MISSION, TEX.—F. Lewis, of San Angelo, Tex., and associates are contemplating the installation of an electric light plant in Mission, for which a site has been purchased.

PORT ARTHUR, TEX.—John W. Gates, of Port Arthur, Tex., is reported to be interested in a project for the construction of an interurban electric railway between Beaumont and Port Arthur, for which surveys have been made. As soon as a franchise has been obtained in Beaumont, it is said that a company will be formed to carry out the project.

TRAWICK, TEX.—The Southern Mills Company is reported to be contemplating the installation of a power plant, including electrical equipment, in connection with the enlargement of its factory in Trawick.

KAYSVILLE, UTAH.—The Davis County Independent Telephone Company has changed its name to the Home Telephone & Electric Company, and the capital of the company has been increased from $40,000 to $250,000. The company proposes to deal in electricity in addition to operating a telephone system.

MIDVALE, UTAH.—The City Council has granted the Utah County Light & Power Company, of American Fork, Utah, a 50-year franchise to furnish electricity for lamps and motors within the city limits. The company will extend its line to provide electrical service in Draper, Crescent, Sandy and Midvale.

PRICE, UTAH.—The contract for the construction of the municipal electric light plant has been awarded to the Capital Electric Company, of Salt Lake City, Utah. The cost of the plant, with power house complete, is estimated at about $18,000. The contract calls for the installation of a 150-kw, three-phase alternator, 150-hp engine and wiring the town for lamps and motors. The street will be lighted by 100 tungsten lamps.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is considering the question of extending its transmission lines from Hydeville north along Lake Bomoseen to the Penrhyn Slate Quarry at Cedar Mountain to furnish electricity at the slate quarry. If the line is extended, it is expected that the summer residents, Hotel Glenwood and the Fair Haven County Club, along the shore of the lake, will utilize the service.

BRISTOL, VA.—The Doe River Light & Power Company, which has contracted to supply the Bristol Gas & Electric Company with electricity for manufacturing purposes, has awarded a contract to the Lowe Construction Company, of Bristol, Va., for the construction of a concrete dam across the Watauga River, in the Horseshoe Bend. The dam will be 48 ft. wide and 300 ft. long, and will cost $250,000.

FORT MONROE, VA.—Bids will be received by Captain Ernest R. Tilton, constructing quartermaster, until May 27, for the construction, including plumbing, heating, electric wiring and fixtures, of nine double sets of non-commissioned officers' quarters, at Fort Monroe, Va. A deposit of $25 will be required to guarantee the return of plans and specifications. Further information will be furnished on application to the Constructing Quartermaster. Plans and specifications may also be seen at the office of the Chief Quartermaster, Department of the East, Governor's Island, N. Y.

RICHMOND, VA.—The citizens of Chesterfield County are negotiating with the Virginia Railway & Power Company to extend its railway from Cockade City to Matoaca. Most of the right of way will be donated by property owners along the proposed railway. C. B. Buchanan, of Richmond, is general superintendent.

RICHMOND, VA.—The contract for erection of the overhead distributing system of the municipal electric light plant has been awarded by the sub-committee of the electric committee to Storms & Company, of Newark, N. J., for $55,000. The award is yet to be confirmed by the full committee. E. D. Richardson is chairman of the committee.

ABERDEEN, WASH.—Local capitalists headed by P. S. Locke have secured power sites on the Chehalis River, and propose to apply to the City Council for a franchise to construct and operate an electric light and power plant in Chehalis.

CENTRALIA, WASH.—The Twin City Light & Traction Company has purchased the entire holdings of the Coal Creek Lumber Company of the Harm & Brown Lumber Company. The new power house of the traction company will be erected on the mill site. Turbines will be installed and slabwood from the mill will be used for fuel. The cost of the power pant is estimated at $75,000.

DAVENPORT, WASH.—J. M. Palmer is reported to have been granted franchises to erect telephone lines over certain roads from Lamona and Odessa.

ILWACO, WASH.—The South Bend Light & Power Company is reported to have taken over the plant and holdings of the Ilwaco Electric

Light Company. It is understood that extensive improvements will be made to the system.

LOON LAKE, WASH.—The town officials are reported to be considering the question of installing an electric light plant and a gravity water system.

MONTESANO, WASH.—The Montesano Light & Water Company is reported to have sold its hydroelectric power plant to Seattle parties, who, it is said, will install a much larger plant.

NORTH YAKIMA, WASH.—It is reported that the plant and holdings of the Northwestern Light & Water Company and the Yakima Valley Power Company are to be taken over by the Northwestern Corporation, of Portland, Ore., in the near future. It is understood that extensive improvements will be made, including the connection of the transmission system of the Northwestern plant with the transmission lines at Pasco.

SEATTLE, WASH.—The City Council has passed an ordinance providing for the installation of cluster lamps on several streets in the city according to plans prepared by the city engineer.

SNOHOMISH, WASH.—The Seattle, Snohomish & Everett Railway Company has been granted a 25-year franchise by the City Council to construct and operate an electric railway in Snohomish. The proposed railway will connect Seattle, Bothell, Snohomish and Everett, work on construction of which will soon commence. Charles W. Kimball, of Seattle, Wash., is secretary and treasurer.

WALLA WALLA, WASH.—The Northwestern Corporation is reported to have decided to build an interurban electric railway between Walla Walla and Pasco, Wash.

WALLA WALLA, WASH.—The H. M. Byllesby Company, of Chicago, Ill., has purchased the properties of the North Western Gas & Electric Company of Walla Walla, which includes the gas, electric light and power plants located in Walla Walla, Free Water, Salem, North Yakima and other cities. The price paid for the properties is said to be $5,000,000. The purchasing company already owns gas plants in Tacoma, Olympia, Everett, Wash., and Portland, Ore.

WINLOCK, WASH.—The J. A. Vaness Lumber Company has contracted with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for its mill, consisting of a 300-kw, three-phase, 480-volt, 60-cycle, 3600 r.p.m., steam turbo-generator condenser, two 25-kva transformers, switchboard and four induction motors, ranging from 20 to 200 hp.

LANSING, W. VA.—The capital stock of the Lansing Telephone Company, of Lansing, W. Va., has been increased from $5,000 to $30,000.

WHEELING, W. VA.—The Wheeling Traction Company is reported to be contemplating the installation of new steam turbines, which will increase the output of its plant by 50 per cent. The company is also said to be considering the erection of a new power house for the purpose of centralizing the power service for its various divisions. George O. Nagle is general manager.

BALDWIN, WIS.—The capital stock of the Baldwin Telephone Exchange has been increased from $25,000 to $50,000, the proceeds to be used for extensive improvements to the system.

BLACK RIVER FALLS, WIS.—The contract for the equipment for the municipal electric light plant has been awarded as follows: For power house equipment, to the Power Engineering Company, of Minneapolis, Minn., for $4,000; for the installation of generator and switchboard to the Fort Wayne Electric Company, of Fort Wayne, Ind., at $5,000. The cost of the new power house is estimated at $3,500.

JANESVILLE, WIS.—The Rock County Telephone Company has purchased the 300-mile toll line of the Badger State Telephone Company.

MADISON, WIS.—Orders have been placed by the Madison Gas & Electric Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1000-kw, three-phase, 2300-volt, 60-cycle, 3600 r. p.m., steam turbo-generator.

MILWAUKEE, WIS.—The Supreme Court of Wisconsin has upheld the lower courts in the ruling on the injunction preventing the erection of a municipal electric plant in Milwaukee. The court, in effect, holds that the question was put to the voters with insufficient clearness.

MINERAL POINT, WIS.—The Mineral Point Zinc Company is reported to be contemplating enlarging its plant. The equipment will include additional furnaces, condensers, a new crushing outfit, storage bins, together with an electrically operated crane.

NEW LONDON, WIS.—It is reported that John Jennings & Company, of New London, Wis., is contemplating the construction of a shingle mill, for which electrical and operating machinery will be required.

PLATTEVILLE, WIS.—The Interstate Light & Power Company expects to be able to supply electricity for lamps and motors in Platteville and vicinity by July. The company proposes to furnish electrical service to mines in this vicinity.

RACINE, WIS.—The City Council is considering the question of replacing the present street lighting system with a new and up-to-date system. The Milwaukee Electric Railway & Light Company furnishes the electrical service in Racine.

SUPERIOR, WIS.—The Minneapolis, St. Paul & Sault Ste. Marie Railway Company, it is reported, will award contracts for ore and coal-handling machinery, power equipment, motors, controllers and pneumatic devices in the near future for its large dock which is now being constructed by the company in Superior. Thomas Greene, of Minneapolis, Minn., is chief engineer.

THERMOPOLIS, WYO.—The North Platte Irrigation Company has recently awarded a contract to the Wagner Electric Company, of St. Louis, Mo., for the installation of an electric power plant about a mile below its large reservoir on the LaPrele, work on which will begin at once. The plant will have an output of about 6000 hp and will furnish electricity for pumping water from the river for domestic and commercial purposes.

FORT SASKATCHEWAN, ALTA., CAN.—The proposition to appropriate $10,000 for the construction of an electric light plant on the Sturgeon River in accordance with plans prepared by Mr. Lynn, will soon be submitted to the ratepayers.

FRASER MILLS, B. C., CAN.—Plans are being prepared by the Fraser River Lumber Company, of Fraser Mills, B. C., for the construction of a cedar mill and sash and door factory, and for a shingle mill at Anacortes, Wash. The mills will be equipped for electrical operation.

NELSON, B. C., CAN.—The Nelson Electric Tramway Company has awarded the contract for the construction of five miles of new track to L. G. Brandt, of Nelson, B. C., including road-bed, switches, pole system and trolley wires. J. McPhee, of Nelson, is superintendent.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company has awarded the contract for the construction of its five-mile extension to Chilliwack to J. W. Pike, of Vancouver.

MINNEDOSA, MAN., CAN.—Plans for the proposed hydroelectric power plant for the town have been prepared by C. H. and P. H. Mitchell, of Toronto, Can.

WINNIPEG, MAN., CAN.—It is reported that the E. B. Reese Engineering Company, which has a water power site at Keewatin, Ont., has been offered a contract to supply Winnipeg with electricity at the rate of $20 per hp per year. The contract calls for a minimum supply of 2500 hp.

BROCKVILLE, ONT., CAN.—At an election held April 25 the citizens voted to issue $50,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. C. T. Wilkinson is manager of the municipal electric light plant.

MONTREAL, QUE., CAN.—A reduction in the rates charged for electricity for lamps has been announced by the Montreal Light, Heat & Power Company. Under the new schedule the price for five-year contracts for residential lighting has been reduced from ten cents per kw-hour to eight cents per kw-hour, and for commercial lighting, from 10 to nine cents per kw-hour.

YORKTON, SASK., CAN.—The construction of an electric light plant to cost $24,000 is under consideration by the Town Council.

DAWSON, YUKON DISTRICT, CAN.—The North Fork Power Company will soon commence work on the construction of an extensive development on the north fork of the Klondike. Seven and one-half miles of ditch will be built. Charles Boyle, resident manager of the Canadian Klondike Company, has charge of the work.

MADERA, CHIHUAHUA, MEX.—The Madera Lumber Company, of Madera, is planning to install an electric light and power plant at the new town of Pearson, where it is erecting two new lumber mills. The power plant will have an output of 3200 hp. Hiram S. Smith is manager of the Madera Lumber Company.

MEXICO CITY, MEX.—The National Congress has made an appropriation for installing incandescent lamps upon the towers of the cathedral in this city. It has been the custom to illuminate the towers of the cathedral during the annual celebration of the country's independence. The illumination will now be made permanent and continued throughout the year.

TEZIUTLAN, PUEBLA, MEX.—The new copper smelter of the Teziutlan Copper Mining & Smelting Company, recently completed, will be operated by a 3000-hp hydroelectric power plant erected by the company a few miles from the mining camp. The company will soon commence work on the construction of another hydroelectric plant near its Ocotes copper mine, in the State of Oaxaca. The plant will be located on the Sola River and will have an output of 1400 hp.

New Industrial Companies.

THE ACTIVE SPECIALTY COMPANY, of Camden, N. J., has been chartered by J. A. Barry, F. M. Kegrize and L. T. Condon, of Camden, N. J. The company is capitalized at $50,000 and proposes to carry on a business as mechanical and electrical engineers, machinists, metal workers, etc.

THE ADVANCE ENGINEERING COMPANY, of Louisville, Ky., has been incorporated with a capital stock of $10,000 by Horace R. Pierce, C. A. McQuay and B. N. McGraw.

THE BLUE EARTH ELECTRIC COMPANY, of Chicago, Ill., has been chartered by Gladys Radtke, Clara W. Woodworth and Anna Louise Holman. The company is capitalized at $5,000 and proposes to manufacture and sell electrical specialties.

THE BONOM INTERNATIONAL STEAM TURBINE COMPANY, of Paterson, N. J., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing steam turbines. The incorporators are: A. Bonom, A. Brunner and A. Romelia, of Paterson, N. J.

THE COLE-HATCH MACHINERY COMPANY, of Kittery, Maine, has been chartered with a capital stock of $125,000 to manufacture motors of all kinds. The officers are: A. H. Peavey, president, and E. J. Burnham, treasurer and clerk, both of Kittery, Maine.

THE EDUCATIONAL TOY COMPANY, of Jamestown, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical machinery, supplies and toys, etc. The incorporators are: C. M. Imus, F. A. Imus, Jr., of Jamestown, N. Y., and D. Cornell, of Warren, Pa.

THE ELECTRIC SUPPLY COMPANY, of Parkersburg, W. Va., has been incorporated with a capital stock of $5,000 by T. A. Bennington, N. C. Burwell, E. P. Chancellor, Jr., W. M. Smith and Joseph A. Wetherell, all of Parkersburg The company proposes to conduct a general wholesale and retail electrical construction business and manufacture and sell electrical machinery.

THE IMPERIAL MUSICPHONE COMPANY has filed articles of incorporation, with a capital stock of $25,000, with the Secretary of State. The incorporators are: F. M. Shive, S. E. Robertson and H. W. Davis, of Wilmington, Del.

THE JOHN M. ROGERS WORKS, of Gloucester, N. J., has been incorporated by J. M. Rogers, F. C. Rogers, of Camden, N. J., and J. M. Hamor, of Philadelphia, Pa. The company is capitalized at $50,000 and proposes to do a general mechanical engineering business.

THE MIDLAND ENGINEERING & CONSTRUCTION COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $5,000 by C. M. Stringer, H. J. Smith, of Oklahoma City, Okla., and William Herndon, of Valley Center, Kan.

THE NEW PROCESS MACHINERY MANUFACTURING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000 by E. L. Quackenbush, of Chatham, N. J.; E. O. Stanley, Jr., of East Orange, N. J., and G. W. Perry, of Orange, N. J. The company proposes to manufacture machinery, etc.

THE RELIANCE ENGINEERING & EQUIPMENT COMPANY, of Milwaukee, Wis., has been organized for the purpose of dealing in new and second-hand machinery and also to prepare plans for industrial and power plants. The offices of the company will be located at 330 Clinton Street, Milwaukee, Wis. A branch office will also be opened in San Francisco, Cal.

THE STANDARD ELECTRIC FITTINGS COMPANY, of Stamford, Conn., has filed a certificate of incorporation with a capital stock of $20,000. The company proposes to manufacture machine fittings. The incorporators are: Harry C. Smith, Charles H. Booth and August B. Church, all of Stamford, Conn.

THE UNIVERSAL SMOKE SEPARATING COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $1,500,000. The incorporators are: F. G. Anderson, of Reading, Pa.; R. C. Lupton and G. G. Steigler, of Wilmington, Del.

THE WAPPLER ELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $150,000 by C. B. Stackpole, of New York, N. Y.; W. W. Hoag, of New Rochelle, N. Y., and H. B. McKenzie, of Brooklyn, N. Y. The company proposes to manufacture and deal in electrical machinery of all kinds; also electrical apparatus for surgery, etc.

THE WORCESTER ELECTRICAL MANUFACTURING COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $30,000 for the purpose of manufacturing and selling electrical devices. J. McGrady is president and J. P. McGrady treasurer, both of Worcester, Mass.

THE WULFF ENGINEERING COMPANY, of Tarrytown, N. Y., has been chartered with a capital stock of $15,000 by Eberhard J. Wulff, Charles MacDonald and Walter E. Stockwell, all of Tarrytown, N. Y. The company proposes to do an electrical, mechanical and hydraulic engineering business and general construction work.

New Incorporations.

BAKERSFIELD, CAL.—The Hudson Electric Company has been chartered with a capital stock of $75,000 by J. B. Murdock, J. W. Ragsdale, C. C. Painter, R. E. Woods, H. E. Smith, J. A. Felter and A. A. McCumber.

TAFT, CAL.—The Moren Electric Company has been incorporated with a capital stock of $75,000 by J. W. Ragsdale, C. C. Painter, R. E. Woods, H. E. Smith, J. A. Felter and A. A. McCumber. The company proposes to furnish electricity for lamps, heat and motors and telephone and telegraph purposes, and to manufacture ice for cold storage purposes; also to generate gas for lighting and heating purposes and construct and operate water works systems. It is expected to have the electric plant in operation within 30 days.

CLARKSVILLE, KY.—The Clarksville & New Providence Railway Company has been chartered with a capital stock of $25,000 to construct an electric railway from Clarksville to New Providence. The incorporators are: Austin Peay, N. L. Carney, L. Bloch, E. L. Trahern and A. C. Murray.

CALAIS, MAINE.—Articles of incorporation have been filed for the Woodland Light & Water Company, with a capital stock of $5,000. The company proposes to supply electricity, gas and water. The officers are: A. L. Hobson, of Boston, Mass., president; J. M. Lavin, of Woodland, Maine, treasurer, and R. T. Curran, of Calais, Maine, clerk.

PORTLAND, MAINE.—The Union Gas & Electric Company has filed articles of incorporation with a capital stock of $10,000. The officers are: E. A. Turner, president; C. W. Smith, treasurer, and L. W. Dyer, clerk, all of Portland, Maine.

HAGERSTOWN, MD.—The Blue Ridge Railway Company has been incorporated with a capital stock of $15,000 to construct an electric railway from Pen-Mar Park to Blue Ridge Summit, a distance of three miles. The officers are: George B. Beaver, president; John G. Benedict, secretary, and W. B. Stottlemyer, treasurer.

CAMDEN, N. J.—The Atlantic City Lighting Company has filed articles of incorporation with a capital stock of $125,000 to operate electric light plants, etc. The incorporators are: William B. McDonald, George W. Chandler and Henry L. Chew, all of 104 Market Street, Camden, N. J.

NEW YORK, N. Y.—Articles of incorporation have been filed for the Ithaca-Auburn Power Company by A. H. Flint, of New York, N. Y.; H. A. Clark and R. L. Post, of Cornell Heights, Ithaca, N. Y., The company is capitalized at $500,000 and proposes to generate electricity for lamps, heat and motors.

GREENVILLE, S. C.—Articles of incorporation have been filed for the Carolina Light & Power Company, with a capital stock of $10,000, by C. M. Bauskett, J. P. Carlisle and B. S. Harris.

HARTSVILLE, S. C.—The South Carolina Western Railway Company has been chartered with a capital stock of $20,000 minimum, maximum $500,000, to construct a 40-mile railway, to be operated by steam or electricity, from McBee Stokes Bridge, Darlington, Florence and intervening towns. The officers of the company are W. R. Bonsal, of Hamlet, N. C., president, and S. O. Beaursfeld, of Hamlet, secretary.

WATERTOWN, TENN.—The Watertown Home Telephone Company has been chartered with a capital stock of $5,695 by A. C. Phillips, C. C. Davis, E. P. Jennings, J. H. Payne, T. W. Moore and others.

JOURDANTON, TEX.—The Jourdan Ice, Light & Water Company has been chartered with a capital stock of $30,000 by Robert P. Coon, F. B. Wallace, R. R. Smith and others.

NORTH YAKIMA, WASH.—The Englewood Water & Power Company has been incorporated with a capital stock of $1,560 by H. R. Linse and others.

SEATTLE, WASH.—The Waupello Corporation has been organized with a capital stock of $100,000 by Andrew P. Johnson, Charles Eugene Banks and J. F. Roy Erford. The company proposes to develop water power plants to furnish light and power.

HARPERS FERRY, W. VA.—The Jefferson Power Company has filed articles of incorporation for the purpose of constructing a hydroelectric power plant at Bull's Falls, on the Shenandoah River. The incorporators are: George R. and Gordon Bready, of Harpers Ferry, W. Va.; Horace Thayer, of Wilmington, Del.

WASHINGTON, WIS.—The Washington Inland Telephone Company has been incorporated with a capital stock of $3,000 by William Jess, John Gislason, G. O. Mann, M. Foss and B. Johnson.

WATERTOWN, WIS.—The Ebenezer Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are: E. W. Schultz, Frank Petro and E. F. Wilman.

OTTAWA, ONT., CAN.—The Ottawa, Rideau Valley & Brockville Railway Company has been incorporated to construct an electric railway from Chelsea to Hull and across the interprovincial bridge and on to Brockville. The directors are: A. Diarmis, R. G. Elliott, of Montreal; F. E. Henning, E. N. Clark, G. E. Kidd and D. H. McLean, of Ottawa, and James Gilmour, of Brockville.

TORONTO, ONT., CAN.—The Toronto & Eastern Railway Company has filed articles of incorporation for the purpose of constructing an electric railway from Coburg to Toronto, with branches to Peterboro, Uxbridge and Lindsay. F. L. Fowke is interested in the project.

Personal.

MR. A. L. KENYON has resigned his position as chief engineer of the Empresas Electricas Associadas, Lima, Peru, to return to the United States.

DR. A. S. McKENSIE, professor of physics at Dalhousie University, has accepted an appointment as professor of physics at Stevens Institute of Technology.

MR. J. R. RICHARDSON has been appointed manager of the Chicago office of the Pacific Electric Heating Company, succeeding Mr. H. F. Holland, resigned.

DR. ROSSITER W. RAYMOND, who has been secretary of the American Institute of Mining Engineers for the past 30 years, was the guest of honor at a dinner given in New York on May 7 to celebrate his 70th birthday.

MR. PAUL SHOUP, assistant general manager of the Southern Pacific Company, has been placed in charge of the electric railway lines owned by the company.

MR. HARRY BROWNLEE, formerly the Berkeley, Cal., representative of the Pacific States Telephone & Telegraph Company, has been made manager of the San Jose district for the company.

MR. T. THORN BAKER, of London, is visiting this country for the purpose of conducting experiments relating to the cabling of pictures across the Atlantic by means of the so-called "telectrograph."

MR. ROBERT E. CHETWOOD, formerly with the New York Telephone Company, has accepted a position as engineer of construction with the Western Union Telegraph Company, with headquarters in New York.

MR. CHARLES T. JEFFERY, who for 16 years was a partner with his father, the late Thomas B. Jeffery, in the firm of Thomas B. Jeffery & Company, now assumes complete control of the manufacture and sale of Rambler automobiles.

MR. E. W. GOUCH, formerly electrical superintendent for J. G. White & Co., at Pottsville, Pa., has been appointed assistant to the general manager of the New York & Queens Electric Light & Power Company, at Long Island City.

PROF. W. M. RIGGS, director of the engineering department of Clemson Agricultural College, and a member of the American Institute of Electrical Engineers, has been appointed a member of the South Carolina Public Service Commission.

MR. W. E. D. STOKES, JR., the 14-year-old president of the Junior Wireless Club of America, acted as representative of the amateur wireless operators at a committee discussion of Senator Depew's bill providing for the regulation of wireless communications.

PROF. L. A. HERDT, local honorary secretary of the American Institute of Electrical Engineers at Montreal, will shortly receive the degree of Doctor of Science from McGill University, where he has served as professor of electrical engineering for some time and is now head of the department.

MR. HARRY S. COOPER, manager of the Galveston Electric Company, has tendered his resignation to take effect on June 1. Mr. Cooper has been in active charge of the street railway and lighting properties of the company for the past six years, during which the entire property has been practically reorganized and reconstructed.

MR. HENRY F. HOLLAND has resigned as manager of the Chicago office of the Pacific Electric Heating Company to accept the position of general salesman for the Simplex Electric Heating Company. In his new position the activities of Mr. Holland will embrace a wide territory, but for the first year he will make his office in Chicago.

PROF. F. B. CROCKER is at Hollywood, Cal., where he will remain until recovery from an attack of asthma. Prof. Crocker, it will be recalled, arrived at San Francisco some weeks ago after a trip through the Orient, forming part of a tour around the world. It is to be hoped that the illness will be of short duration and that Prof. Crocker will soon be again among his eastern friends.

MR. WILLIAM PERTAK has recently joined the Westinghouse Electric & Manufacturing Company, and will be connected with the detail and supply department at East Pittsburgh, to assist in the development of the company's business in heating apparatus, including industrial heating appliances. During the last five years Mr. Pertak has been sales manager of the Prometheus Electric Company, New York.

MR. D. F. FRADETTE, formerly contract agent of the Des Moines (Ia.) Electric Company, has been associated with the Merchants' Heat & Light Company, of Indianapolis, Ind., since the first of the year in the capacity of contract manager. Profiting by his experience in developing an ornamental street lighting load in Des Moines, Mr. Fradette has applied himself to the same task in Indianapolis with success.

DR. W. H. TOLMAN, Director of the American Museum of Safety, has been delegated by the Department of State to represent the United States at the Ninth International Housing Congress to be held in Vienna next month. At this congress will be assembled the leaders of the international movement for improving housing, and the reports from the United States will summarize the progress of the movement in this country.

MR. C. B. KEYES has been appointed assistant district manager in the Traction Department of the General Electric Company for New York City and adjacent territory. The department is in charge of Mr. S. W. Trawick. Mr. Keyes has been connected with the General Electric Company for a number of years, having been recently in charge of railway construction work in New York City territory, and previously connected with the Railway Engineering Department at Schenectady.

MR. BUTLER KEYS, for many years with the Consolidated Car-Heating Company and recently with the Home Rubber Company, has been appointed manager of the sales department of the Hemming Manufacturing Company, with headquarters at No. 2 Rector Street, New York. This company owns the Hemming and Gummon patents and has completed a plant for the manufacture of fireproof and waterproof molded insulating materials, under these patents, at Garfield, N. J.

MR. J. B. COMSTOCK, for six years with the Westinghouse Electric & Manufacturing Company at its East Pittsburgh works, and for four years manager of its publication department and printing plant, severed his connections with that company in April to accept a similar position with the P. & F. Corbin Company of New Britain, Conn. Prior to Mr. Comstock's connection with the Westinghouse Company he filled the same position with the Corbin Company that he has recently been recalled to assume.

MR. HAROLD M. WILSON, who for the past seven years has been connected with the sales department of the Prometheus Electric Company, New York, has recently accepted a position with the Westinghouse Electric & Manufacturing Company. He will be in the detail and supply department and will assist in the development of the company's business in both domestic and industrial heating apparatus. For the present Mr. Wilson will be located in the Westinghouse Company's Pittsburgh District Office.

MR. H. H. SEAMAN, who for the last six months has been assistant manager of the electrical department of the H. W. Johns-Manville Company, New York, and who, previous to this time, was connected with the Electric Storage Battery Company, of Philadelphia, has resigned his position to take charge of the business of his father, who died recently. In the future, Mr. Seaman's address will be care of W. S. Seaman & Company, Milwaukee, Wis., manufacturers of telephone booths and automobile bodies.

MR. H. K. HERRICK, engineer in charge of construction of the Mississippi River waterpower dam at Keokuk, Ia., has been made a member of the board of directors of the Keokuk & Hamilton Waterpower Company, which is carrying out this development and will operate the 200,000-hp hydroelectric generating station. Mr. Herrick is a graduate of the Civil Engineering School of Purdue University, and has been engaged in a number of important engineering works, among them the construction of the McCall Ferry waterpower development.

MR. FREDERICK W. WALKER, of Detroit, has been selected by the committee of 50 chosen by Mayor Breitmeyer of Detroit about a year ago to formulate a plan for the settlement of the street railway franchises, to take general charge of the practical end of the city's side of the contest over the appraisal of the Detroit United Railway. A court of arbitration has been formed composed of three men selected by the city and D. U. R. to decide upon the physical value of the street railway property. It is expected that this board of arbitration will reach an agreement on the value of the street railway property not later than June first.

MR. WILL J. SANDS, who for the past six years has been manager of the hydraulic-turbine and pumping-engine department of the Allis-Chalmers Company, has resigned that position in order to take up consulting engineering work in Boston. Mr. Sands began his career with Dr. E. D. Leavitt, of Cambridge, Mass., and has been connected with the Dickson Manufacturing Company, of Scranton, Pa.; William Cramp's Sons, Philadelphia, and the International Steam Pump Company, New York. He has also served on the Metropolitan Water Board of Massachusetts and the New York City Burr-Freeman-Hering Water Supply Commission. While in Boston he will give personal attention to the Sands Engineering Company, which was organized there several years ago.

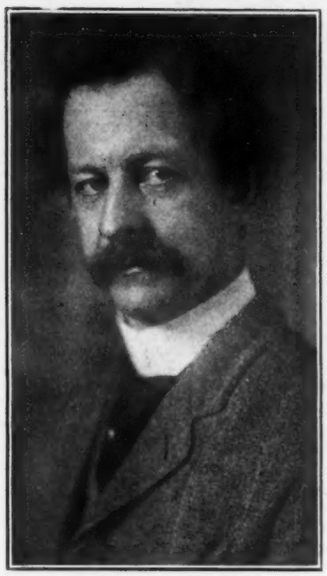
MR. THOMAS CRAWFORD, who was recently elected president of the Iowa Electrical Association, was born at Sterling, Ill., in the year 1874. He attended the local schools in Sterling and prepared for college at that place. At the age of 20 he graduated from the electrical engineering course at the University of Illinois. Immediately upon graduation he was appointed superintendent of the Sterling Gas & Electric Company, for which he had worked previously during vacation periods. In 1905 he moved to Clinton, Ia., to become general manager of the Clinton Gas Light & Coke Company, which position he now occupies. Mr. Crawford is also chief electrician of the Clinton Gas Light & Coke Company, and general manager of the Maquoketa Light & Heat Company.

MR. THOMAS CRAWFORD

MRS. LASALLE STOOPS, who was an interested delegate in attendance at the convention of the Arkansas Public Utility Operators at Pine Bluff, Ark., April 27 to 29, is one of the few women in the world who take an active part in the management of an electric light plant. This lady purchases all machinery and supplies for the 150-kw, steam-driven system at Stuttgart, Okla., a town of 3500, and herself makes all estimates for new work, installations and service, solicits new business, supervises billing and collects all accounts. She is thoroughly familiar with the various phases of operation of an electric company, and has managed the Stuttgart plant, which she and her husband own, for almost six years. When the property was taken over at that time, 700 lamps were connected to the lines; the number has since been increased to 3500, and 24-hour service is now rendered to 100 hp in motors. Only one gasoline engine remains in the town, which is in the center of an important rice-growing district.

Obituary.

MR. TOWNSEND WOLCOTT.—It is with deep regret that we announce the death of Mr. Townsend Wolcott, which occurred Friday evening, April 29, of pneumonia, after an illness of but a few days.



MR. TOWNSEND WOLCOTT.

Mr. Wolcott, who was born in New York City, July 18, 1857, was a member of the family of that name from which for generations many men notable in public and private life have descended. For some years he was historian of the family association and edited the printed report of the annual reunion which is held in various parts of the country. From an early age Mr. Wolcott had a strong taste for scientific studies, especially mathematics, physics and chemistry. He learned the trade of machinist, and as apprentice and journeyman devoted his spare hours to the systematic study of both the technical and theoretical side of mechanical engineering, and later of electrical engineering. About 1880 he entered the electrical field permanently, and at different times served as electrical engineer or technical adviser to a number of electrical companies exploiting various branches of the art, including lighting, power, storage battery work and electro-metallurgy. During this period he contributed largely to electrical literature. For the past ten years he has been electrical inspector and electrical engineer at New York for the Signal Corps of the United States Army.

Mr. Wolcott joined the American Institute of Electrical Engineers in 1888, and has always been an active participant in the discussion of papers read before that body. In the days when the Institute was, in the face of no little discouragement, laying the foundations upon which its present prosperity is based, Mr. Wolcott was one who could always be called upon for any service, which the more appealed to him if it involved self-sacrifice and was of a kind that did not entail formal acknowledgment upon accomplishment. Particular mention should be made of his service on the membership committee, which extended over more than ten years, and commenced at the time when transfer to the higher grade of membership ceased to be a perfunctory act. During this period and owing largely to the thorough examination of qualifications, the status of the senior grade of the Institute was raised to a standard only equalled by one other American professional body. The elevated professional ideals of Mr. Wolcott and his thorough independence of personal or other influence contributed in no small degree to the attainment of this high status.

While Mr. Wolcott never reached in the electrical profession the high position for which his exceptional intellectual ability and intimate knowledge of electrical science fitted him, his actual attainments were recognized by members of that profession, as was also an unalterable adherence to high ideals that at times appeared to approach eccentricity. His position in all matters involving professional ethics was, however, but a manifestation of personal character inflexible in its rectitude. This may be illustrated by two instances within the knowledge of the writer. On one occasion, Mr. Wolcott was offered a flattering salary to act as scientific adviser in the development of a process which the inventor supposed, in good faith, rested upon a previously unknown physical relation; after an interview the position was refused and the would-be employer informed that he was culpable in having wasted a large sum of other people's money on a process obviously wrong in principle. On another occasion a well-known manufacturer offered Mr. Wolcott a good fee to design a machine to accord with a new principle of operation, which offer was refused with the statement that it would be much better to pay a still larger sum to prevent the design of a machine entirely wrong in principle, and which, if constructed, would lead to a large loss of money, as subsequently proved to be the case. The position which Mr. Wolcott occupied during the last ten years of his life and at the time of his death—electrical engineer at New York of the United States Signal Corps—included the inspection of electrical material for Government use, both in course of manufacture and on delivery; and the integrity with which he discharged his duties in this connection brought him the highest respect both of contractors and army officials, and partly accounted for relations of friendship with army officers of a kind not often contracted with a civilian employee. Mr. Wolcott possessed in a high degree those traits of character which make the world better, though at times their possession may militate against personal worldly success.

MR. GEORGE F. PORTER, former secretary of the National Electric Light Association, died at 11 p. m., Friday, April 29, of apoplexy, at his home in Montclair, N. J. Mr. Porter's long official connection with the National Electric Light Association brought him a wide acquaintance, both in central station and electrical manufacturing circles, and his genial disposition attracted the warm friendship of all he met. Few men are favored with a multitude of friends such as paid homage to the sterling qualities of George Porter, and the regret among this host will be the more poignant that the end came without warning and when he was in the full strength of all his powers. Mr. Porter was born on March 12, 1855, in Pittsburgh, Pa., and was graduated from the public schools of that city in 1871. Beginning life as a civil and mechanical engineer, he abandoned a professional career in 1873 to enter the iron business, which he followed up to the fall of 1875. During this year he first turned his attention to the electrical field, commencing as a telegraph operator. Until 1877 he was connected with the Pullman Palace Car Company in its Philadelphia office. From this line of work he again entered the iron business, in which he continued, with the exception of about one year, until 1883, during which period he was connected with the engineering department of the Pittsburgh & Western Railroad. Later he went into the carbon business, and subsequently held a position with the Westinghouse Electric & Mfg. Company in its Philadelphia office. In 1892 he was appointed secretary of the National Electric Light Association, which office he held continuously until 1902. In 1904 he became Master of Transportation of the Association, and last week was busily engaged in making transportation arrangements for the St. Louis convention of this month. Shortly after appointment as secretary of the Association, Mr. Porter became connected with the insulated wire industry, and thenceforth held responsible positions with several of the large wire manufacturing companies. When, in 1902, the Atlantic Insulated Wire & Cable Company was organized, Mr. Porter became a director, the secretary and general sales manager, which offices he held at the time of his death. Mr. Porter is survived by a widow and two daughters.

MR. GEORGE F. PORTER.

Trade Publications.

SPARK COIL.—A compact spark coil for gas engines, wound with enamel wire and built to mount directly upon the engine, thus saving one wire, is the subject of a 6-page folder issued by the Muskegon Coil Company, of Muskegon, Mich.

REMOTE CONTROL SWITCHBOARDS.—The Walker Electric Company, switchboard manufacturer, of Philadelphia, Pa., has issued an interesting bulletin describing the remote control switchboard equipment installed in the Wanamaker Store in Philadelphia.

TELEPHONE BRANCH EXCHANGE SWITCHBOARDS.—Bulletin 1005 of the Western Electric Company illustrates and describes branch exchange equipments designed for use in business establishments, factories, schools or places where a private telephone system is required.

METAL CONDUIT.—A 6-page folder of the National Metal Molding Company, Pittsburgh, Pa., points out some of the advantages of Sherarduct, a metal conduit treated by a special process by which zinc is deposited upon the surface of the iron. It is claimed to be superior to galvanized iron.

FANS.—The value of fans in promoting comfort in the home and efficiency in the office and factory is set forth in an attractive booklet of the Robbins & Myers Company, Springfield, Ohio. The booklet is No. 88. It is so made that it can be enclosed in an envelope or sent as a post card. Folder 86 illustrates and describes various wall, desk and ceiling fans.

METAL LOCKERS.—Lessened fire risk and improved sanitary conditions are the most important advantages of metal lockers and furniture for offices and factories. Edward Darby & Company, Philadelphia, Pa., have just issued Catalog No. 43, which is devoted to metal lockers for clothes and materials. The variety of lockers made by the company is extensive, and full particulars of each type are given.

VACUUM CLEANER.—The advantages of vacuum cleaning are set forth in a 16-page 6-in. x 9-in. booklet of the Houston Manufacturing Company of Rockford, Ill., which is devoted to its vacuum cleaning system. The power apparatus and dust tank are in the basement with pipes running to different parts of the building. These plants are always designed to fit the work to be done.

MOTOR FANS.—The Westinghouse Electric & Manufacturing Company has recently issued some very attractive publications describing its line of electric motor fans. A 56-page, 7-in. x 10-in. book is devoted to the entire line, while two booklets, 3½ in. x 6 in., describe direct-current and alternating-current equipment respectively. A great deal of taste is displayed in the get-up of these booklets.

RURAL TELEPHONE LINES.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y.. has issued a 24-page, 5¼ in. x 7½ in., booklet entitled "How to Build a Rural Telephone Line." The booklet tells how to build and operate a magneto telephone line, such as would be used in rural districts. A nominal price of 10 cents has been put on the book, but the Stromberg-Carlson Company has offered the book free to any subscriber of the *Electrical World*.

INDUCTION MOTOR STARTER.—A small 6-page folder of the American Electric Fuse Company, of Muskegon, Mich., illustrates and describes a unique type of starter. Carbon disks form the resistor which is inserted in the motor leads while starting. The closing of the switch operates a mechanism which gradually decreases the resistance until it is finally completely short-circuited by the closing of the switch. The danger of leaving the switch in the starting position is eliminated.

STEAM AND AIR FLOW METERS.—Bulletin No. 4720 of the General Electric Company describes steam and air flow meters. The economical generation or consumption of steam, like that of electricity, gas and other commodities, depends on accurate information which will show the amount being generated, consumed or distributed. Equally important is the determination of the exact amount of air being delivered or consumed, where air is used in place of steam as a working agent. The recording and indicating steam and air flow meters described in this publication provide the means for obtaining such information. This bulletin should be of interest to all central station managers.

GAS ENGINE DRIVEN ISOLATED PLANT.—A unique catalog has just been issued by the Chas. A. Strelinger Company, of Detroit, Mich., in which the choice of prime mover and utilization of electrical energy are set forth in great detail. The book resembles a catalog much less than it does a handbook for electrical salesmen. The latter half of the book is given up entirely to the applications of electricity in small apparatus, such as heating, cooking, vacuum cleaning, small machine driving, drilling, ventilating, etc. Illumination is discussed at length, and comparisons made with all other forms of illuminants in commercial use. This part of the book contains information which will be found very useful by central station solicitors.

BUSINESS NOTES.

THE POWER EQUIPMENT COMPANY, of Chicago, has removed its office from 1407 Fisher Building to 1703 Fisher Building. Mr. S. D. Boynton is manager of this company.

THE WALKER ELECTRIC COMPANY, through Mr. H. F. Haviland, its western manager, announces the removal of its Chicago office from 204 Dearborn Street to the Monadnock Building.

THE CLEVELAND TWIST DRILL COMPANY on May 1 moved its Chicago Branch to No. 9 North Jefferson St., where it has greatly improved facilities for the prompt handling of a rapidly increasing business.

THE ELECTRIC STORAGE BATTERY COMPANY'S ST. LOUIS STORE.—The Electric Storage Battery Company, owing to the increased use of electric vehicles in the Central West, and therefore of the increased demand for "Exide" batteries and renewals, has found it necessary to open a store room for "Exide" material at Sixteenth and Pine Streets, St. Louis, Mo.

THE LORD MANUFACTURING COMPANY, New York, reports that it has been found necessary to add to its list several additional iron and steel and brass foundries, in order to meet the largely increased and constantly increasing demand for its material. The company states that its business is now about 300 per cent greater than at any time within the previous three years, although during that period there was a constant growth.

THE CONTINENTAL WIRELESS TELEPHONE & TELEGRAPH COMPANY has been organized with an authorized capital of $5,000,000 for the avowed purpose of operating a wireless service on the Great Lakes. The companies already in existence which have merged into the new company are the Clark Wireless Telegraph-Telephone Company, the Pacific Wireless Telegraph Company, the Massie Wireless Telegraph Company and the Collins Wireless Telegraph Company. It is claimed by the promoters of the enterprise that a wireless service will be established by it from "coast to coast."

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Spring meeting, Pittsburg, Pa., May 4, 5, 6 and 7, 1910.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Jefferson, N. H., June 27-30, 1910.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., June 20-24, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Lake Rosseau, July 6, 7 and 8, 1910.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 21, 22 and 23, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria. Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Davenport, Ia., April, 1911.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich. Next meeting, Port Huron, Mich., August 16, 17 and 18.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Greenville, Miss., June 15, 1910.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham. Next meeting, St. Louis, April, 1911.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, June 1, 2 and 3, 1910.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, C. H. Hodskinson, 89 Lafayette St., Boston, Mass.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., May 10, 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

PACIFIC COAST ELECTRICAL EXHIBITION, San Francisco, Cal., May 21, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

PITTSBURG ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex. Next meeting, Beaumont, Tex., May 12-14, 1910.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, G. H. Pardee, care of J. G. White & Co., New York. Next meeting, Cooperstown, N. Y., June 27 and 28, 1910.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Lena M. Owen, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WASHINGTON ELECTRICAL SHOW, October or November, 1910.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WINNIPEG ELECTRICAL SHOW, Winnipeg, Manitoba, July 13 to 23, 1910.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 26, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

955,863. TROLLEY WHEEL; B. B. Gibbs, Minneapolis, Minn. App. filed Nov. 21, 1908. Has grooved bearings on the sides of the center to act as finders for the wire.

955,895. FIXTURE AND REFLECTOR FOR VACUUM TUBES; D. McF. Moore, Newark, N. J. App. filed Apr. 16, 1908. The reflector is made in sections with projections and is built up into a continuous reflector over the tube.

955,921. TELEPHONE RECEIVER; H. R. Stuart and E. O. Kizer, Wheeling, W. Va. App. filed April 19, 1909. Magneto receiver with an annular magnet, an inwardly projecting portion carrying poles.

955,923. TELEPHONE; W. H. Thompson, Wheeling, W. Va. App. filed March 18, 1909. Receiver and transmitter are mounted on a pliable handle compressed at the ends to receive them.

955,929. WATCHMAN'S SIGNALING AND FIRE ALARM SYSTEM; G. M. Willis, Chicago, Ill. App. filed Nov. 16, 1907. Includes a break wheel operating a contact and driven by a gear spring with segmental gear and additional contact members, which are disconnected and the circuit opened by rotation of the shaft in one direction.

955,984. AUTOMATIC ELECTRIC GENERATOR SYSTEM; M. A. Newstetter, Dec'd., Reading, Pa. App. filed Nov. 20, 1908. A dynamo driven by a gas engine in which a storage battery controls means for starting and stopping the engine.

955,985. AUTOMATIC ELECTRIC GENERATOR SYSTEM; M. A. Newstetter, Dec'd., Reading, Pa. App. filed May 20, 1909. A dynamo driven by a gas engine in which a storage battery and instruments are used for starting and stopping the engine.

955,986. AUTOMATIC ELECTRIC GENERATOR SYSTEM; M. A. Newstetter, Dec'd., Reading, Pa. App. filed May 20, 1909. A dynamo driven by a gas engine in which a storage battery automatically acts together with another instrument responsive to its charge for starting the engine, and a third instrument controlled by the current stops the engine.

956,047. INCANDESCENT LAMP LOCK; L. Davis, Alton, Ill. App. filed July 31, 1909. For preventing theft of lamp bulbs by means of a locking ring embracing the socket and engaging the bulb and a keeper band surrounding the ring.

956,066. STARTER AND CIRCUIT FOR VAPOR DEVICES; S. E. Flichtner Englewood, N. J. App. filed Jan. 9, 1905. A plurality of tiltable vapor electric devices with a common shunt and individual tilting magnets therefor.

956,109. TRANSMISSION SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Dec. 15. 1908. Telephone system for railroads in which each substation has a primary and secondary winding and a switch in the transmitter circuit for shunting the secondary and then opening the circuit so that telephone currents may pass through the receiver.

956,118. CIRCUIT CLOSER; R. P. Lumley and H. G. Millman, New York, N. Y. App. filed March 29, 1907. A door-operated plunger circuit closer in which the plunger carries a cross-bar and is moved by a spring and an auxiliary plunger and spring assist the action.

956-135. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Feb. 3, 1909. A box with two fixed terminals, a fuse case, a sliding member making circuit with the fuse case and a locking device for the sliding member.

956,136. SWITCH-BLOCK; T. E. Murray, New York, N. Y. App. filed Sept. 9, 1909. For branch circuits in which the base block is of insulating material with tubular passages to receive the branch and main conductor.

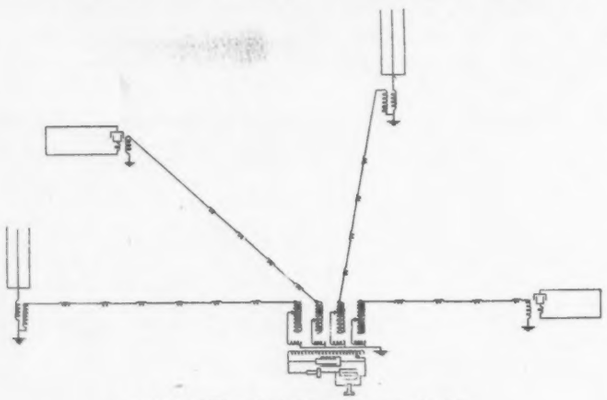
956,161. ELECTRICAL SWITCH RECEPTACLE; J. G. Peterson, Hartford, Conn. App. filed Aug. 31, 1909. For push-button switches, including a cup of insulating material containing a switch mechanism, a frame supporting it, and an insulating cover enclosing the cup.

956,164. MAGNETIC CLUTCH; A. Pick, Vienna, Austria-Hungary. App. filed July 24, 1909. A magnet with armature and friction ring with means for conducting oil through the armature to the ring.

956,165. ELECTRICAL SPACE COMMUNICATION; G. W. Pickard, Amesbury, Mass. App. filed Sept. 3, 1907. Makes use of a plurality of conductor stations separated from the local stations with loaded line conductors connecting the conductor stations with the local stations.

956,168. SYSTEM OF LIGHTING BY GAS OR VAPOR ELECTRIC LAMPS; H. N. Potter, Pittsburgh, Pa. App. filed May 28, 1901. A main circuit including a vapor electric lamp and a secondary of a transformer with a heater for the lamp and an interrupter in circuit with the primary of the transformer, the parts being in shunt to the main lamp circuit.

956,171. TELEPHONIC APPARATUS; T. C. Rafferty, Philadelphia, Pa. App. filed July 24, 1909. For defective hearing in which the transmitter includes a microphone with a diaphragm and several mega-



956,165.—Electrical Space Communication.

phones radiating from the center of the diaphragm to collect the sound and direct it upon the center.

956,174. ELECTRIC LAUNDRY IRON; E. H. Richardson, Ontario, Cal. App. filed June 11, 1909. Includes a hollow body containing an electric heater with a distributing plate having a projection in each corner welded against the body and bearing against the heating elements.

956,186. ARMORED ELECTRIC CONDUCTOR; P. Schroder, Stuttgart, Germany. App. filed June 20, 1908. The covering or sheet has folds at its edges held together by a connecting strip with interlocking edges.

956,228. LONG-DISTANCE TELEPHONIC APPARATUS; V. Tardieu, Arles, France. App. filed Nov. 5, 1904. The transmitter and receiver have hollow chambers harmonically proportioned to each other and contain carbon and metal plates spaced apart to produce the right proportion.

956,246. DEHYDRATING MILK; T. L. White and A. P. Elten, New York, N. Y. App. filed Aug. 9, 1909. Expels the water out of the milk by using a diaphragm and electrical endosmosis, the diaphragm absorbing the water and consisting of a vegetable parchment.

956,250. ELECTRICALLY OPERATED BELL; A. G. Wilson, Wilkinsburg, Pa. App. filed April 3, 1908. For train signals. Rotated by an electric motor while the current is on the motor and bell being supported in the casing.

956,251. TELEPHONE APPARATUS; D. H. Wilson, Chicago, Ill. App. filed April 24, 1905. A transmitter, receiver, induction coil with a plurality of secondaries, the coils of the secondary being connected in series when signaling and a circuit breaker actuated by the core of the induction coil while signaling.

956,255. SELECTIVE SIGNALING SYSTEM; M. W. Zabel, Chicago, Ill. App. filed Feb. 11, 1904. Two conductors with a plurality of selectors associated with different conductors, electric means for selectively operating certain selectors and actuating electric signals.

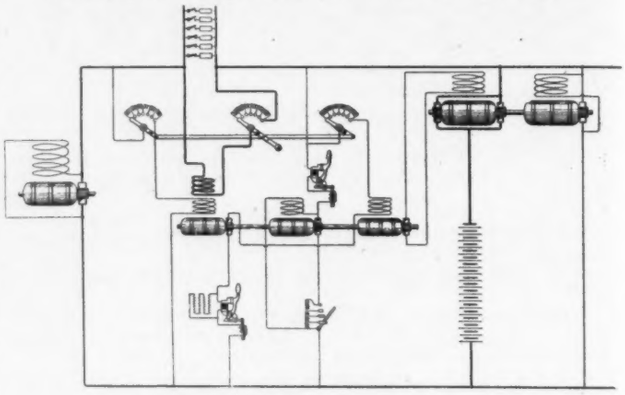
956,265. ELECTRIC LAMP SOCKET; V. T. Bailey, New York, N. Y. App. filed July 20, 1909. An insulator having an insulating base with conductor connections on the face and an insulating cover journaled thereto and having caps moving over the connections.

956,288. BURGLAR ALARM; S. Chritchfield, National Military Home, Ohio. App. filed July 1, 1909. For windows in which the sash controls a sliding bolt which controls an electric circuit and actuates a cartridge.

956,293. BRAKE APPLYING MECHANISM; P. Conniff and Y. Burgess, Washington, D. C. App. filed Feb. 11, 1909. Automatic air-brake in which an electromagnet may have its circuit closed by the engineer, thus controlling the air-valve and reducing the train pipe pressure.

956,353. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 13, 1906. A booster set in which the booster has field windings wound for low current and the exciter therefor has similar windings and an automatic regulator applies to the exciter field a varying resultant of opposing potential differences.

956,354. CHAIN GUIDE FOR PULL SOCKETS; H. Hubbell, Bridgeport, Conn. App. filed May 19, 1909. The chain guide includes a bell through which it passes, attached to an insulating bracket.



956,353.—Electrical System of Distribution.

956,355. CONTROLLER FOR STREET CARS; J. H. Huey, Tarentum, Pa. App. filed Aug. 2, 1909. For the handle of controllers, the top plate having a circular retarding plate with an irregular slot and the lever swinging over the plate and held by a spring-pressed beveled pin.

956,373. COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM; O. T. Lademann, Milwaukee, Wis. App. filed July 23, 1908. For calling telephones on telegraphone lines with a make and break receiving contact signal, a battery, a relay and a closed circuit battery with signal controlling relay having a vibratory contact.

956,377. SWITCHING DEVICE; O. M. Leich and N. Pedersen, Genoa, Ill. App. filed June 19, 1908. For telephone stands in which a plurality of contact springs are operated from the switch hook. Details.

956,379. ELECTRIC DOOR OPENER; Jos. Loch, Brooklyn, N. Y. App. filed June 22, 1909. An arrangement of levers and an electromagnet controlling the keeper and bolt work of a door.

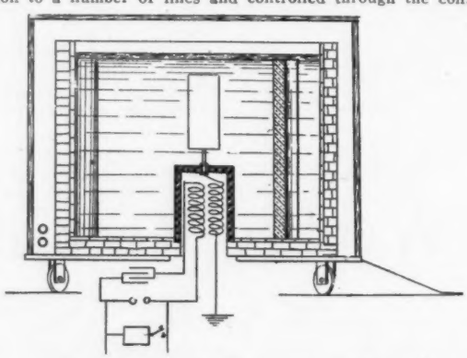
956,380. AUTOMATIC ENGINE STOP; N. C. Locke, Salem, Mass. App. filed Aug. 6, 1907. In case of accident an electromagnet releases an armature which unseats the exhaust valve reducing the boiler pressure and actuates the throttle valve to shut off the engine.

956,419. PANEL BOARD; L. C. Reed, New Orleans, La. App. filed Aug. 9, 1907. For main and branch busbars in which supports are provided for the two outer bars to raise them above the middle bar.

956,421. ELECTRIC SWITCH ATTACHMENT; H. C. Robinson, Coatesville, Pa. App. filed Aug. 17, 1909. A solenoid operated switch including main and auxiliary contacts which are pressed together by the action of the solenoids.

956,461. ARMATURE CASING; B. Whelchel, Anderson, Ind. App. filed Aug. 6, 1909. An armature casing consisting of members whose end walls have inwardly extending flanges and a connecting clamp surrounds the flanges and has a tightening screw.

956,484. TELEPHONE EXCHANGE SYSTEM; E. E. Clement, Washington, D. C. App. filed March 8, 1905. Call registering system, common to a number of lines and controlled through the connective



956,489.—Signaling by Electromagnetic Waves.

apparatus and operated only when lines are connected for conversation, the record being made on a tape by type.

956,489. SIGNALING FOR ELECTROMAGNETIC WAVES; R. A. Fessenden, Washington, D. C. App. filed June 21, 1906. A medium of high specific inductive capacity with an antenna and reflector immersed in the medium.

956,498. ELECTRIC SAFETY FUSE; T. E. Murray, New York, N. Y. App. filed March 11, 1908. The fuse is mounted in a tubular case whose ends are closed by plugs which expand in setting, forming a close joint.

956,502. ATTACHMENT FOR PIANOS AND THE LIKE; A. D. Palmer, Pittsburgh, Pa. App. filed May 14, 1909. For electrically operating drums, bells and other instruments from the keyboard of the piano.